M. SETO

TORONTO AREA WATERSHED MANAGEMENT STRATEGY STUDY

TECHNICAL REPORT #1

HUMBER RIVER AND TRIBUTARY DRY WEATHER OUTFALL STUDY

Ministry of the Environment

Ontario

The Honourable
Andrew S. Brandt
Minister

Brock A. Smith
Deputy Minister

Toronto Area Watershed
Management Strategy Study

Technical Report #1

HUMBER RIVER AND TRIBUTARY DRY WEATHER OUTFALL STUDY

Prepared For The

ONTARIO MINISTRY OF THE ENVIRONMENT

by

Gartner Lee & Associates Ltd.

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EXECUTIVE SUMMARY

A program of sewer outfall mapping and sampling was undertaken during the autumn of 1982 in the Humber River Basin within Metropolitan Toronto. The study was designed to identify which outfalls carry significant contamination to the Humber River. Sewers inventoried included storm sewer and combined sewer outfalls as well as discharge from some 'natural' drainage courses. Two outfall inventories of the entire study area and an intensive sampling of selected outfalls were completed during dry weather flow conditions. A total of 624 outfalls were mapped, of which 366 were active and 239 sampled. Just over one-third of the active outfalls were discharging more than 1 L/s. Eighty-four of the outfalls were considered sufficiently contaminated to warrant intensive water quality sampling and testing.

Levels of a range of chemical parameters including nutrients, metals and phenolics along with bacteriological parameters were determined in discharges from selected outfalls. Water quality data were combined with flow rates to produce average dry weather loading rates for chemical parameters. These loadings were interpreted to priorize the most significant outfalls contributing chemical contaminants to the Humber River within Metropolitan Toronto. Prioritization of outfalls was also made on the basis of Fecal Coliform and Fecal Streptococci concentrations.

The average daily dry weather load of the conventional parameters BOD, COD, suspended solids and phosphorus from the urban watershed is similar to that entering into the study area from

upstream. However, study area sewers contribute significantly more nitrogen, phenolics and metals during dry weather than the upstream contribution. Most significant contributions of chemical contaminatns originate from industrial areas.

A total of 60 outfalls were considered as significant contributors of chemical pollutants, while 30 produced fecal bacterial population densities of more than 10,000 counts per 100 ml of sample.

Twelve outfalls are responsible for the bulk of the total dry weather contaminant loads for all chemical parameters.

Bacteriological parameters were responsible for the designation of the highest number of outfalls as significant contributors followed by the chemical parameters ammonia, lead and BOD.

This study terminated with the identification of significant outfalls. Follow-up actions to locate the actual sources of contamination (e g, cross connections, industrial discharges, etc.) have been initiated by the respective municipalities.

ACKNOWLEDGEMENTS:

The successful completion of this project was dependent upon a team effort by many individuals and organizations. By maintaining open communication channels, completing individual tasks dependably and maintaining a genuine spirit of co-operation, the TAWMS 1 Study Team completed their work smoothly.

We acknowledge the contribution of staff of Metropolitan Toronto and the Cities of Etobicoke and York. As well, Ministry of the Environment staff at several levels provided excellent administrative, technical and advisory support.

Special thanks is directed to the following individuals who contributed most directly:

D. McAdam	...	City of Etobicoke
Chi Ng	...	City of York
Wayne Komer, Mian Shin Sun, Paul de la Rosa	...	Metropolitan Toronto Laboratory
George Zukovs, Henry Kronis, Vera Turner, Fritz Engler, Pashpal Basu	...	Ministry of the Environment
Jim Hennessy, David Melton, Larry Pavlov and Tim Gray	...	Field Crew

1.0 INTRODUCTION:

Recent Ministry of the Environment (MOE) studies of water quality along the Lake Ontario waterfront have shown that the impact of the tributary watersheds within Metropolitan Toronto is very high (TAWMS I Terms of Reference). The Toronto Area Watershed Management Study (TAWMS) has been initiated to develop a management strategy for pollution control within the tributary watersheds and along the lakeshore.

This study, "The Humber River and Tributary Dry Weather Outfall Study" is one of the first in a series of TAWMS investigations. It involves the identification of all sewer outfalls within the Humber River Basin, in Metropolitan Toronto, with repeated sampling of those which are flowing during dry weather periods. The objectives include identifying those outfalls considered to be significant contributors of chemical and bacteriological contamination. Figure 1 shows the study area location.

An earlier MOE study (1972) located 328 outfalls and undertook a limited sampling program. Gartner Lee Associates Limited was retained by the Ontario Ministry of the Environment to supervise field staff in the location of these and all other outfalls, and to prepare a report outlining the study findings. The field work was initiated on August 30, and was completed by December 17, 1982.

KEY MAP

Figure 1

Scale 1: 250,000

1.1 OBJECTIVES:

The objectives of this study were two-fold:

- to identify, map, and describe all the sewer outfalls within the study area;
- to calculate the distribution of contaminant loading from sewer outfalls under dry weather conditions and assign priorities to individual outfalls based on discharge quality and contaminant loading relative to other outfalls. The "priority outfalls" would be highlighted for further investigation by the respective municipalities.

1.2 SCOPE:

"Dry weather outfalls" were judged as those producing a discharge which was not related to runoff from a recent rainfall event. Such outfalls would carry uncontaminated ground water or a chronic flow from unknown municipal and/or industrial sources.

The study initially included all sewer outfalls to the Humber River and its tributaries, within Metropolitan Toronto. These outfalls include storm sewers, combined (sanitary and storm) sewer overflows, direct industrial discharges and any others located.

During the study the scope was expanded to include reconciliation of all outfalls listed in the 1972 MOE report

and on municipal sewer maps. Some of these were not major outfalls and many were found to be draining surface water from vegetated depressions.

Effluent sampling was repeated at active outfalls to allow meaningful calculation of contaminant loadings and identification of contaminated outfalls.

2.0 STUDY APPROACH:

2.1 INTRODUCTION:

The study area consisted of the Humber River Basin within Metro Toronto (Figure 2). It comprises:

- the Humber River between Steeles Avenue and Lake Ontario;
- the West Branch of the Humber River from the Claireville Reservoir to its confluence with the Humber River;
- Black Creek from Steeles Avenue to its confluence with the Humber River;
- all creeks or streams tributary to the rivers listed above.

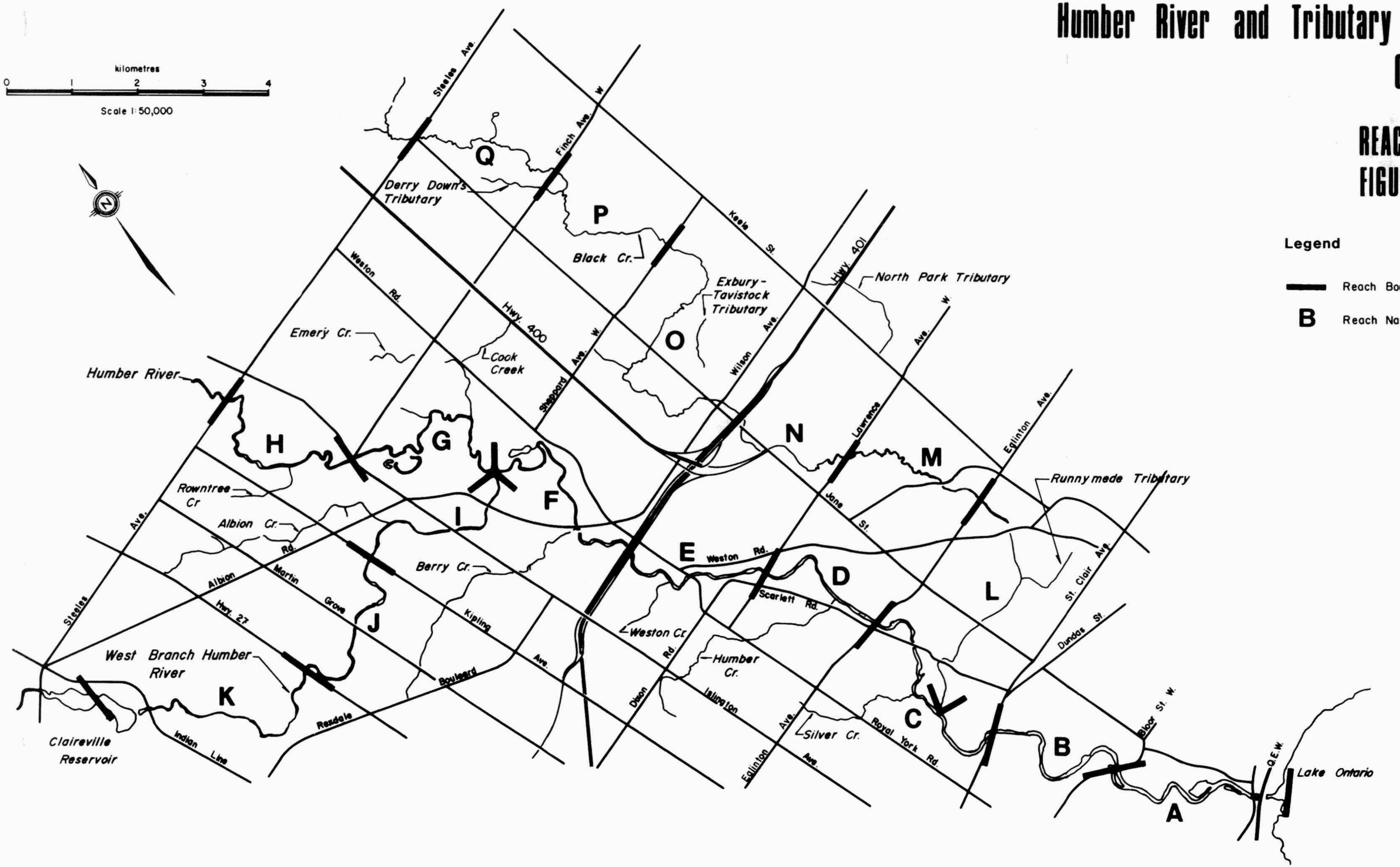
For the purposes of organization and work scheduling, the watercourses were divided into 17 reaches, designated A to Q. The boundaries of reaches were based on major streets or river confluences and are also shown on Figure 2. Day-to-day project management and all data were organized on a reach-by-reach basis.

2.2 FIELD PROCEDURES:

This study was set up as a dry weather study. Consequently on occasions when there was significant

Humber River and Tributary Dry Weather Outfall Study

REACH BOUNDARIES
FIGURE 2



Legend

Reach Boundary

B Reach Name

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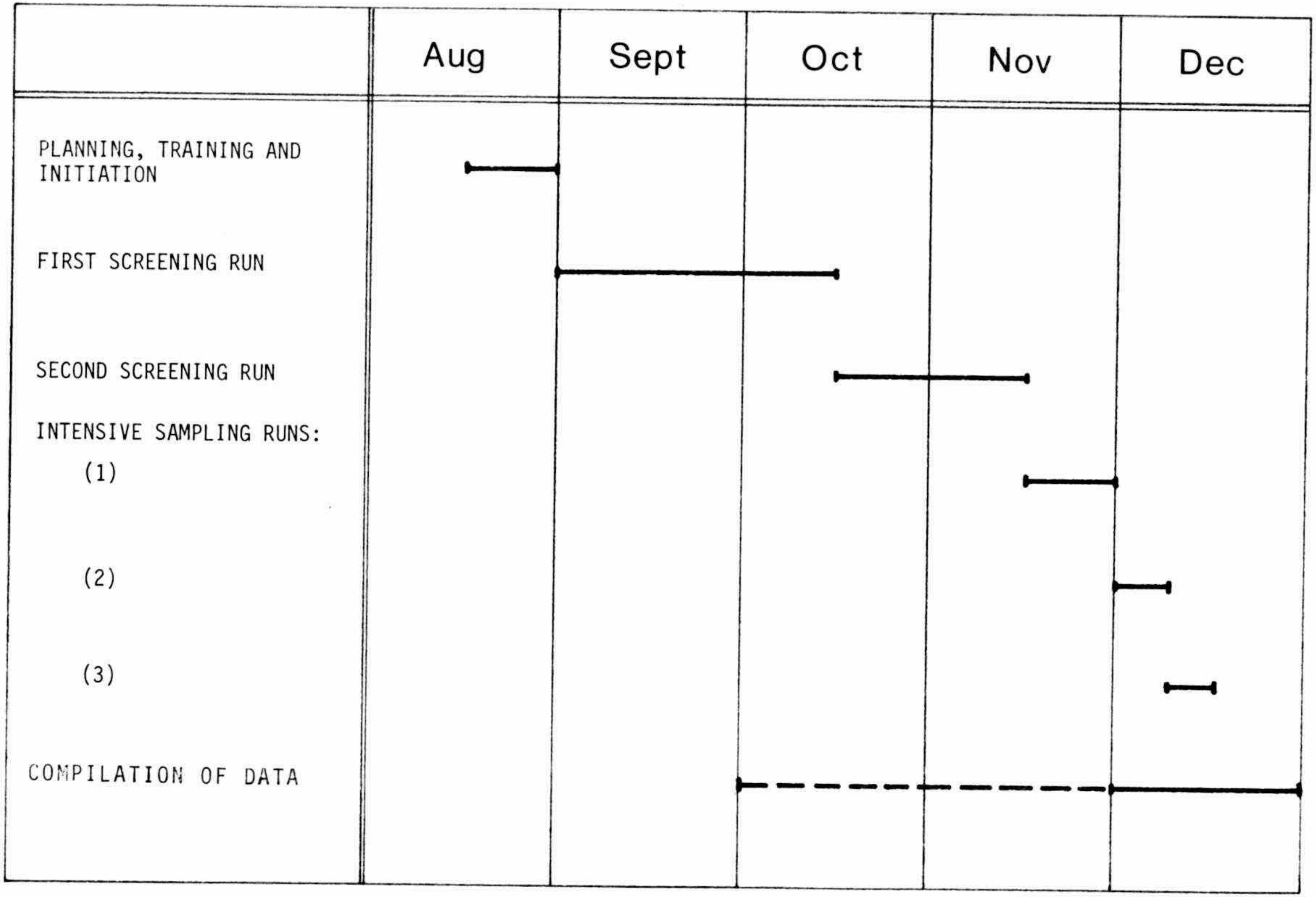
stormwater in the sewer system, sample collection was postponed until dry weather flow conditions prevailed. The presence of storm water was suspected for approximately 12 hours after any storm event. Following storms, water from flowing outfalls was routinely tested for conductivity. If conductivity levels of less than 1000 μmhos/cm were found, rain water inclusion was assumed and sampling postponed, typically for 24 hours.

The training of field crews and familiarization with equipment took place in August and continued during the initial two weeks of field work. The crews were based at the MOE Laboratory to facilitate sample preparation and submission,and equipment maintenance.

The field component of the project was conducted as a succession of combined mapping and effluent sampling runs by two two-man field crews. These runs have been designated as the "First and Second Screening Runs" and the "Intensive Phase". This format was used to facilitate screening of individual outfalls against contamination guidelines or thresholds. The screening process was used to highlight the more contaminated outfalls warranting resampling during the subsequent sampling runs. As the study progressed, the level of the thresholds was increased so that only the most contaminated outfalls were intensively sampled. The Intensive Phase consisted of three separate sampling runs conducted in successive weeks. The timing of the sample collection is shown in Figure 3.

Sampling Schedule

Figure 3



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Field crews were not provided with municipal sewer outlet maps until the second screening run. This was done to prevent the crews from mapping only those outfalls which were previously mapped.

A more detailed description of each of the screening identification and sampling runs follows:

(i) First Screening Run:

The objectives of the First Screening Run were:

- to locate, map and describe as many outfalls as possible without using municipal maps; and
- to sample all actively flowing outfalls during dry weather flow conditions.

In the field, each crew proceeded upstream within each reach traversing both banks. Outfalls were located, Field Data Sheets (Figure 4) were completed and samples were taken from actively flowing outfalls.

Information recorded on Field Data Sheets for each outfall included:

- physical description, location and photographs of the outfall;
- its identification number (hereafter referred to as the Outfall Number);

Figure 4

FIELD DATA SHEET
Humber River Outfall Study

Outfall # ______ Date: __/__/__ Time: ________ Crew: ________

Weather: Today - ____________________

Yesterday - ____________________

River: Humber Main Black Creek Humber West Other ________

Reach: A B C D E F G H I J K L M N O P Q

Borough: Etobicoke Toronto York North York

Location:

(Sketch on back)

Outfall Description: Size - __________ ø W x H - __________

Material - __________ Shape - __________

Active Y / N Photographed Y / N # __________

Samples Collected: Bacteria Routine Chemical Metals Organic Other __________

Flow Rate: Velocity __________

Depth - __________

Sketch cross-section shape (on back)

Field Tests: D.O. ______ mg/L Air Temp ______ °C

pH ______ Water Temp ______ °C

Conductivity ______ umhos

Observations: Colour Odour Erosion Impacts Land Use Other

ACCESSIBILITY: Easy Difficult Road Foot Manhole Boat Only

Is outfall otherwise mapped ? Map __________ # __________

- flow rate (measurable; slight ±0.1 L/s; trickle ±0.01 L/s; none) and field chemistry results (dissolved oxygen, pH, temperature and conductivity);

- general site observations and other municipal identification numbers.

Locations of outfalls were pin-pointed on recent black and white, 1:10,000 scale aerial photographs. Table A1 in Appendix A describes field data collection methods. Water samples were preserved and submitted to the MOE or Metro laboratories.

The Outfall Number was painted on each outfall. Even numbers were assigned by one field crew, odd numbers by the other crew. When new outfalls were located in reaches that had been previously mapped they were numbered according to the last outfall identified by the crew, rather than the numbers on adjacent outfalls. Late identifications were made in this manner since previously painted outfalls could not be conveniently re-numbered.

A list of the parameters analysed during the First and Second Screening Runs is provided in Table 1.

Reach maps were prepared to show the location of each outfall. Figure 5 is an example of a Reach Map.

TABLE 1: PARAMETERS ANALYSED AND LABORATORIES UTILIZED DURING THE FIRST AND SECOND SCREENING RUNS

PARAMETER	ABBREVIATION	LABORATORY
Biochemical Oxygen Demand	(BOD_5)	Metro
Chemical Oxygen Demand	(COD)	Metro
Total Kjeldahl Nitrogen	(TKN)	MOE
Ammonia	(NH_3)	MOE
Total Phosphorus	(Tot-P)	MOE
Soluble Phosphorus	(Sol-P)	MOE
Iron	(Fe)	Metro
Copper	(Cu)	Metro
Zinc	(Zn)	Metro
Lead	(Pb)	Metro
Chromium	(Cr)	Metro
Suspended Solids	(SS)	Metro
Phenolics	(Phnl)	MOE
Fecal Streptococci	(F.S.)	MOE
Fecal Coliforms	(F.C.)	MOE

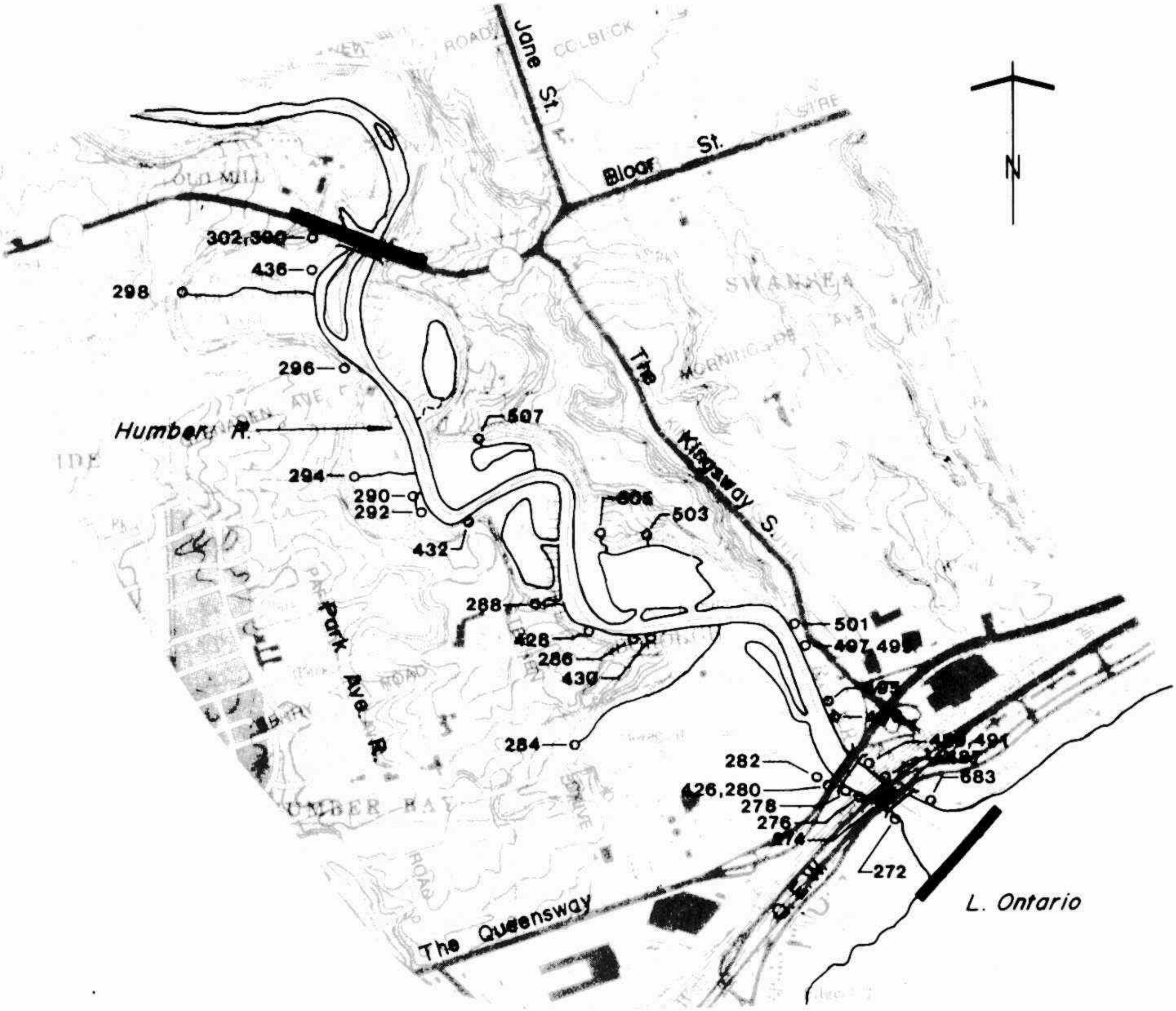

FIGURE 5

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach A

Legend

o—— 284	Outfall Location & Identification
	Weir
	Bridge
	Reach Boundary

Scale 1: 15,000

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(ii) Second Screening Run:

A preliminary mapping of outfalls and reconciliation with existing maps indicated that a number of outfalls had been overlooked during the First Screening Run.

During the Second Screening Run the field crews used municipal maps, lists and information from the 1972 MOE study to locate outfalls which may have been overlooked. Any additional outfalls were mapped, described, and sampled as described under *"First Screening Run"*.

Water quality data from the First Screening Run were evaluated and outfalls were screened to prevent the re-sampling of relatively clean water during the second run. The guidelines used to select outfalls to be re-sampled are provided in Table 2. At the suggestion of MOE staff, these values were based on proposed limits for storm sewer discharges in Metro Toronto. Effluents exceeding these levels were re-sampled as part of the Second Screening Run. The second run took place in October and November 1982 (Figure 3).

TABLE 2: GUIDELINES USED TO SELECT OUTFALLS FOR SAMPLING DURING SECOND SCREENING RUN (LOW THRESHOLD)

PARAMETER	OUTFALL RE-SAMPLED IF CONCENTRATION EXCEEDED (mg/L)
BOD_5	20
COD	25
TKN	5
NH_3	1
Tot-P	1
Sol-P	1
Fe, Cu, Zn, Pb, Cr	1
S.S.	15

(iii) Intensive Sampling:

The original Terms of Reference indicated that during the Intensive Phase, sampling of approximately 30 outfalls would be repeated six times. Samples would be analysed for an expanded list of parameters.

Available screening run data indicated that a large number of these intensive tests would be undertaken on samples that were only contaminated by one or two parameters, e.g. high levels of BOD but with negligible metals present. Secondly, a high proportion of the laboratory test allocation had been used during the two screening runs because of the unexpectedly large number of active outfalls sampled (222). Discussions were held with the MOE to devise a more efficient intensive sampling program that would fulfill the objectives of the study and maximize the return on the remaining laboratory testing allocation.

At the completion of the Second Screening Run the available analytical data were reviewed and a second set of contaminant guidelines drawn up as a "high threshold" to identify the most contaminated outfalls. The values of the parameters used to select outfalls for intensive sampling are given in Table 3. This list is based largely on the proposed Metro Storm Sewer By-Law with the exceptions of BOD, COD, iron and suspended solids whose "high threshold" was set higher than the By-Law to identify the most contaminated outfalls. In addition, thresholds were set for phenolics, fecal streptococci and fecal coliforms. Values were

chosen to highlight only the most contaminated outfalls for each parameter.

At any outfall, samples were taken only for the particular parameters exceeding the high threshold with BOD, COD and bacteria being treated as one test group. This provided BOD, COD and bacterial information on a reasonably widespread basis to facilitate basin-wide analysis and reduced the number of metals analyses requested. The intensive sampling consisted of three separate runs in November and December. The locations of outfalls sampled during the intensive phase are shown on Figure 6. A list of parameters tested and the respective testing laboratory is given in Table 4.

TABLE 3: GUIDELINES USED TO SELECT OUTFALLS FOR INTENSIVE SAMPLING (HIGH THRESHOLD)

PARAMETER	OUTFALL EFFLUENT INTENSIVELY SAMPLED IF LEVELS EXCEEDED (mg/L)
BOD_5	50
COD	50
TKN	5
NH_3	1
Tot-P	1
Sol-P	1
Fe	5
Zn, Cu, Pb, Cr	1
SS	100
Phenols	5 μg/L
Fecal Streptococci	- 10,000/100 ml
Fecal Coliforms	- 50,000/100 ml

Humber River and Tributary Dry Weather Outfall Study

OUTFALLS SAMPLED DURING INTENSIVE PHASE
FIGURE 6

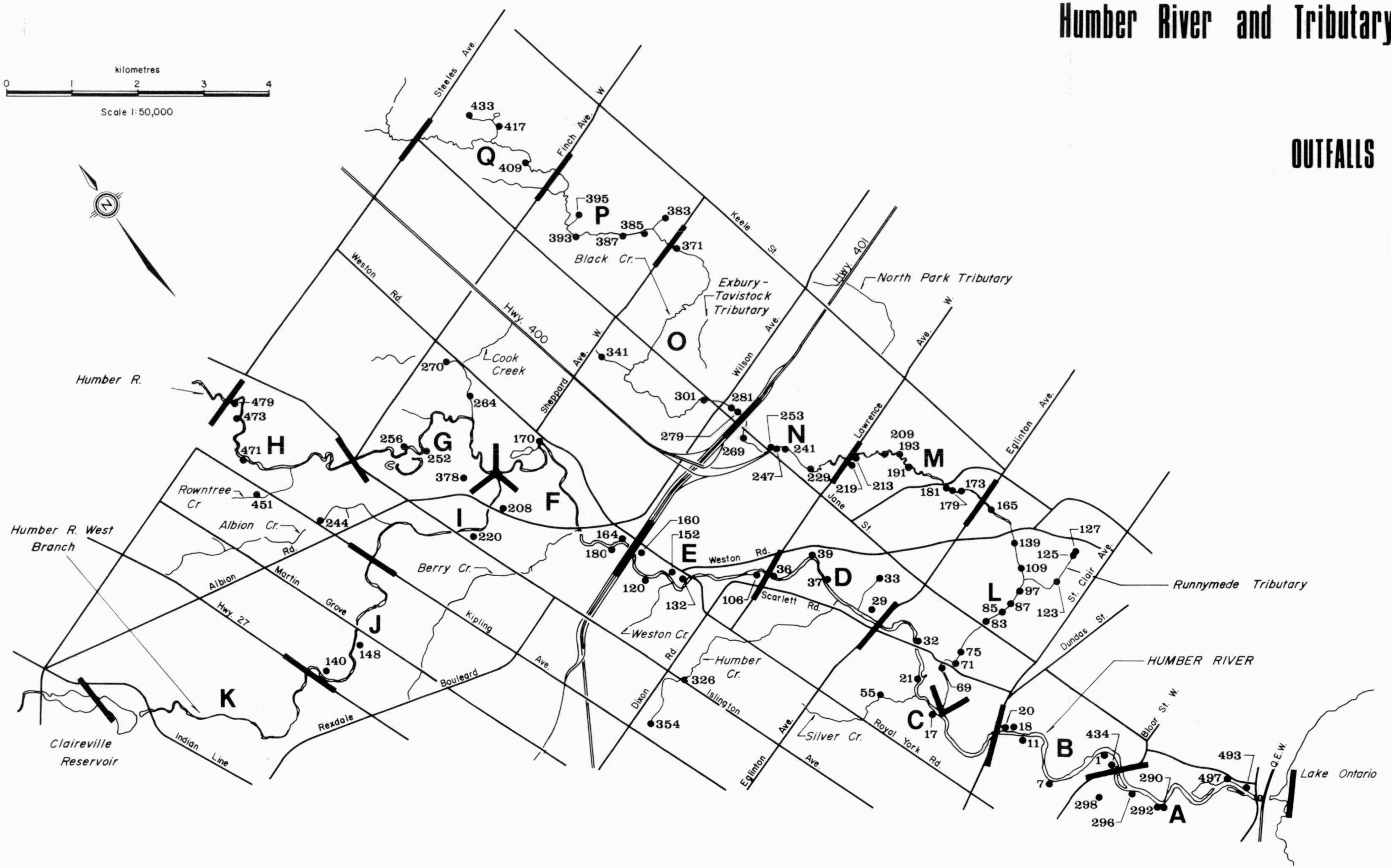

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TABLE 4: PARAMETERS ANALYSED AND LABORATORIES UTILISED DURING THE INTENSIVE PHASE

PARAMETER	LABORATORY
Biochemical Oxygen Demand	Metro
Chemical Oxygen Demand	Metro
Total Kjeldahl Nitrogen	Metro
Ammonia	Metro
Nitrate-Nitrogen (NO_3-N)	Metro
Nitrite-Nitrogen (NO_2-N)	Metro
Total Phosphorus	Metro
Soluble Phosphorus	Metro
Iron, Copper, Zinc	Metro
Lead, Chromium	Metro
Mercury (Hg)	MOE
Metal Scan	MOE
Suspended Solids	Metro
Volatile Suspended Solids (V.S.S.)	Metro
Phenols	MOE
Organic Compounds	MOE
Fecal Streptococci	MOE
Fecal Coliforms	MOE

During the first of the three intensive runs (November), samples were taken at all outfalls showing high levels of metals and submitted for a "metals scan" at the MOE laboratory to determine the presence of metals, other than the five routinely tested. As well, a limited sampling program was undertaken for organic parameters. The results of this work are being followed up by MOE staff and will be reported separately.

2.3 LABORATORY TECHNIQUES:

During this project two laboratories were used:

- MOE Laboratory at Resources Road, Rexdale
- Metro Toronto Wastewater Laboratory on Dee Avenue, Rexdale

The parameters tested by each laboratory are given in Tables 2 and 4. The following are analytical notes compiled to assist with interpretation of the data.

- MOE LABORATORY: The procedures used for each parameter were the standard MOE procedures as described in the Outline of Analytical Methods (MOE, 1981). The metal scans were done using Inductively Coupled Argon Plasma Source Emission Spectroscopy (ICP). Organic analyses were conducted using gas chromatography.

- METRO TORONTO LABORATORY: In general, the procedures set out in Standard Methods for the

Examination of Water and Wastewater, 15th Edition, 1980 were followed. Further details of the analytical procedures are contained in Appendix A.

The detection limits of laboratory tests used in this study are given in Appendix A.

2.4 DATA PROCESSING:

As analytical results became available, they were transferred onto master sheets containing all chemical and field data for each outfall. The master sheets were continuously updated as information became available from the first and second screening runs. This information was used to select outfalls for resampling during the second screening run and for intensive sampling. The analytical data, in conjunction with physical descriptions were compiled into a computerized data base. Appendix B is a printout of the analytical data for this study. These data are organised in numerical order, by reach, in 2 lists (A & B) to facilitate electronic printing. The units of these data are given at the end of List B.

2.5 LOADING CALCULATIONS:

Chemical contaminant loading calculations were made for two purposes:

- to estimate the dry weather chemical contaminant load from outfalls to the Humber River in Metro Toronto and review its distribution with respect to the loading from outside the study area during Fall 1982; and

- to help priorize individual outfalls for further investigation.

Loads were calculated by multiplying the mean chemical contaminant concentration by the mean discharge (flow rate) to provide a mean dry weather loading in grams per day (g/day).

Background contamination loads in the Humber River were also calculated for the three locations where the major rivers enter the Metro Toronto study area, i.e.:

- West Branch of the Humber River at the Claireville Reservoir (WBHR)

- Humber River at Steeles Avenue (HR)

- Black Creek at Steeles Avenue (BC)

These locations were given outfall identification numbers to make them compatible with the data processing system.

The following terms are used in the loading calculations and interpretation:

- The "total loading" refers to chemical contaminant contributions from outfalls within the study area for each individual parameter.

- "External sources" are the Black Creek, the Humber River and the West Branch of the Humber River as they enter the study area at Steeles Avenue or the Claireville Reservoir.

- The "Grand Total Loading" is from all sources i.e. outfalls plus external sources for individual chemical parameters.

Results of the loading calculations are presented in Chapter 4 and Appendix A.

3.0 OUTFALL LOCATIONS AND CHARACTERIZATION:

During the First Screening Run, 432 outfalls were mapped, 157 were sampled and 2,900 laboratory tests conducted. By the Second Screening Run, 605 outfalls had been mapped, 222 had been sampled and 4,000 tests conducted. By the end of the study, a total of 624 outfalls were identified and mapped. The field data sheets (Figure 4) for each outfall are presented separately in Appendix C. An Outfall List has been prepared giving outfall locations, municipal I.D. Numbers, a summary of discharges and sampling activity. Table 5 is an example of this List, which is presented in Appendix D. The List is organized by Reach, with outfalls appearing in the order they appear in the field, moving in an upstream direction. Locations of the individual outfalls are shown on the Reach Maps (Figures 7 through 23) contained in this report. To assist the reader to identify specific outfalls on maps and access corresponding data, a "Numerical Listing of Outfall Locations" is given in Appendix A as Table A2 and Appendix D as Table D1.

Of the 624 outfalls mapped, 366 (59%) were flowing under dry weather conditions. Flows in excess of 1 L/s were observed in 137 of the active outfalls while flows exceeding 10 L/s were measured in 18 of the outfalls.

Effluent quality was characterized initially by determining pH, temperature, dissolved oxygen and conductivity levels in the field. No unusually acidic or caustic discharges were found and no temperatures exceeding 21^{o}C were noted. In-field dissolved oxygen results were

SAMPLE OUTFALL TABLE

Reach: A

Stream: HUMBER RIVER

Table 5 P. ____

Outfall #	1972 Report #	Borough Outfall #	Borough	Location	Description	Activity	Sampling
683		H1	T	50 m S of Lakeshore Drive, Side of Retaining Wall on E Bank	750 mm ϕ CMP, Side of Wall, Submerged	No	
272		7EAWJ 28H4	E	W Bank, at Mouth of River, 10 m S of Lakeshore Eastbound	1720 mm ϕ conc	Yes	*
274	HM1	L408A 7EAWD-72HU	E	Between Lakeshore E & Gardner Eastbound, W Bank	620 mm ϕ CMP	Yes	
276			E	W Bank, Between QEW & CN Railway Bridge	620 mm ϕ CMP	Trickle	
487		H2	T	E Bank, N of QEW & S of Railway Bridge	380 mm ϕ	No	
278	HM4	L408B 7EAWD-56HU	E	Just N of CN Bridge (5 m) & S of Queensway Bridge. W Bank	240 mm ϕ conc	Trickle	
489	HM2	H3	T	E Bank, 20 m N of Railway Bridge	900 mm ϕ conc	Trickle	Δ
491	HM3	H4	T	E Bank, 22 m N of Railway Bridge	1100 mm ϕ CMP	No	
426	HM5	7EAWD-34HU	E	1 m S of Outfall #280, W Bank	160 mm ϕ CMP	No	
280	HM6	H101 7EAWD-58HU	E	Beneath the Queensway W Bound Bridge, Under Wooden Foot Bridge	1070 mm ϕ conc	Trickle	
282	HM7	7EAWC-74HU	E	10 m U/S From Outfall 282. 30 m From Bank of River, W Bank	1525 mm ϕ conc	Stagnant	
493		H5	T	20 m N of Lackies Marina Driveway, 5 m from River	1200 mm ϕ CMP	Yes	*Δ ϕ
495	HM8		T	30 m N of Driveway of Lackie's Marina, on Side of Hill	300 mm ϕ CMP	No	

*-Sampled On 1st Run Δ – Sampled On 2nd Run ϕ – Sampled Intensively

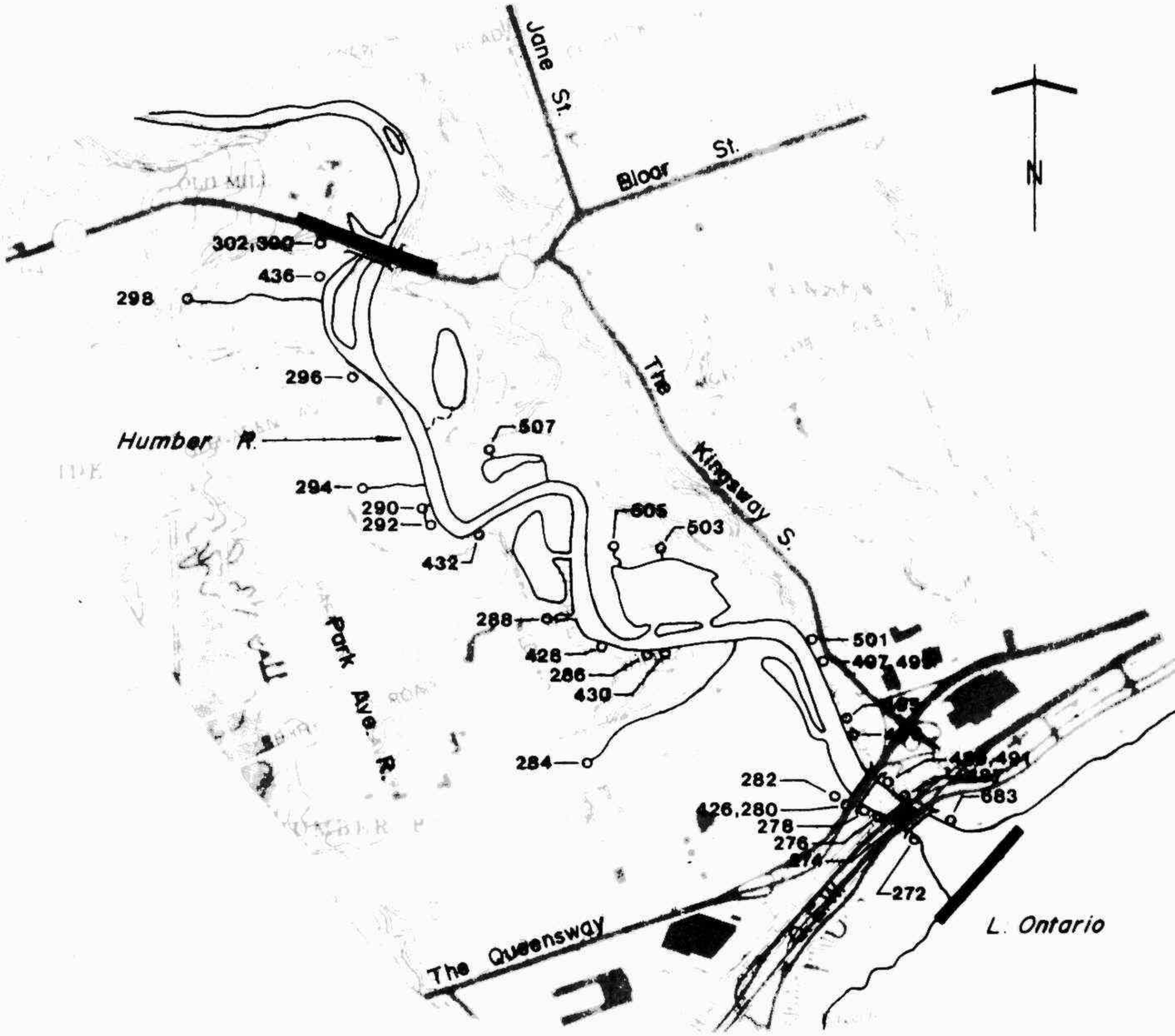

FIGURE 7

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach A

Legend

o——284 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1:15,000

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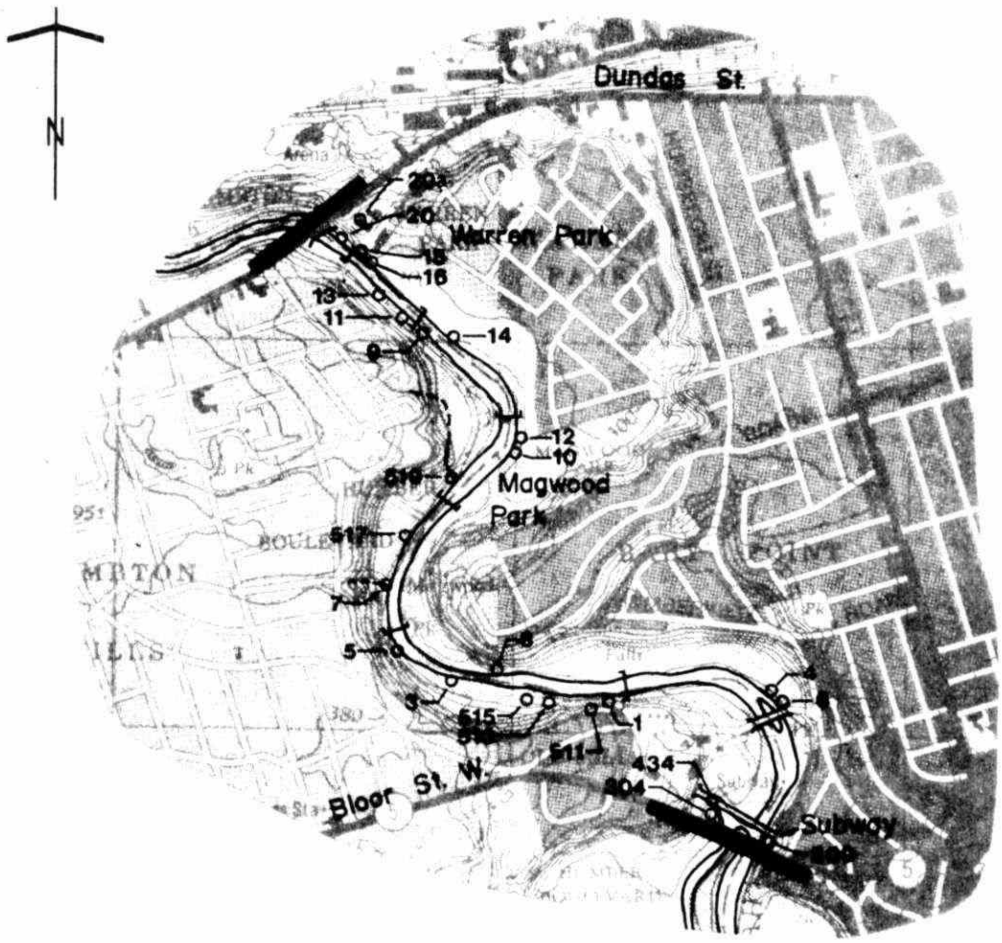

FIGURE 8

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach B

Legend

o——20 **Outfall Location & Identification**

Weir

Bridge

Reach Boundary

Scale 1:15,000

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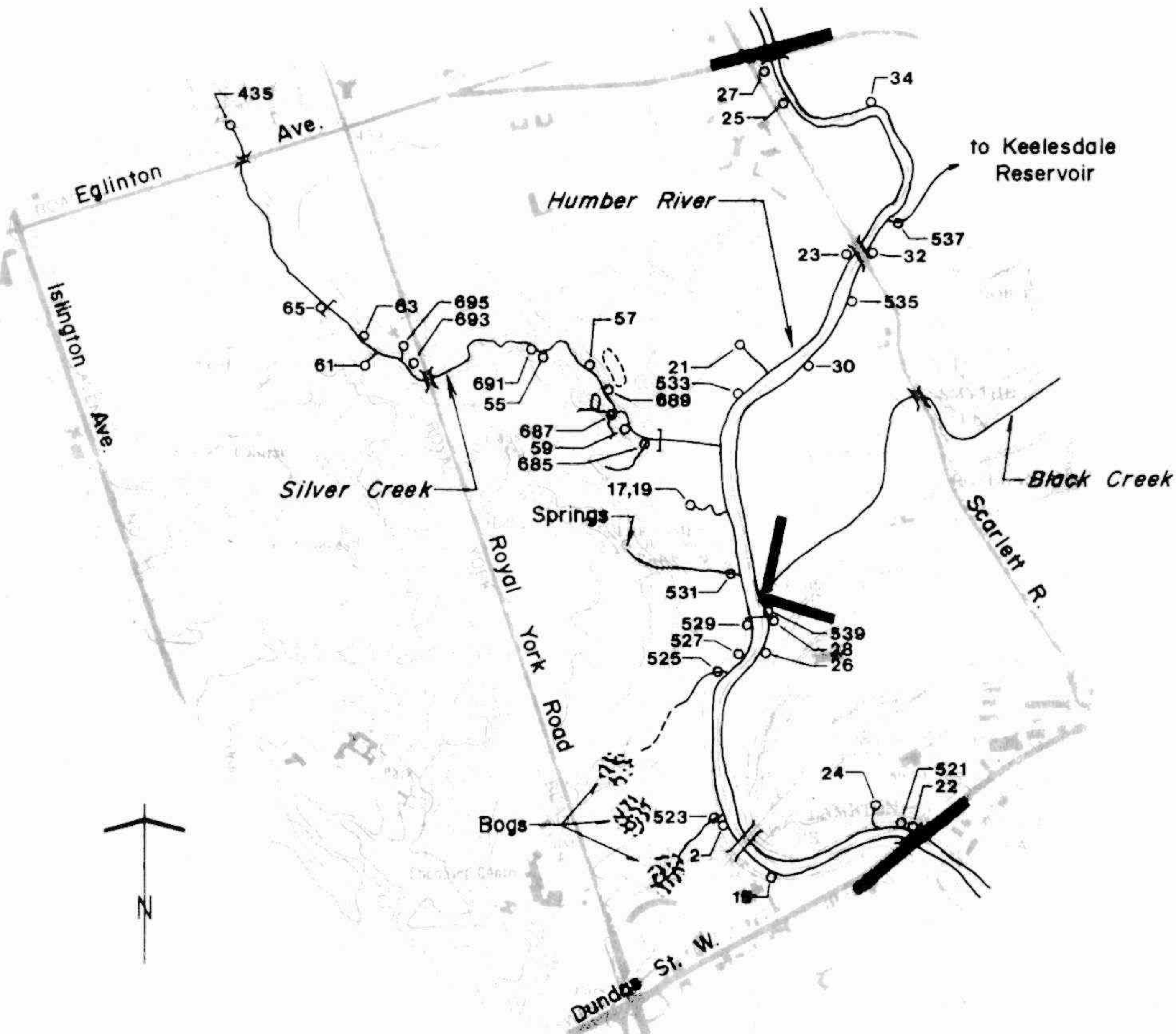

FIGURE 9

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach C

Legend

687 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1:15,000
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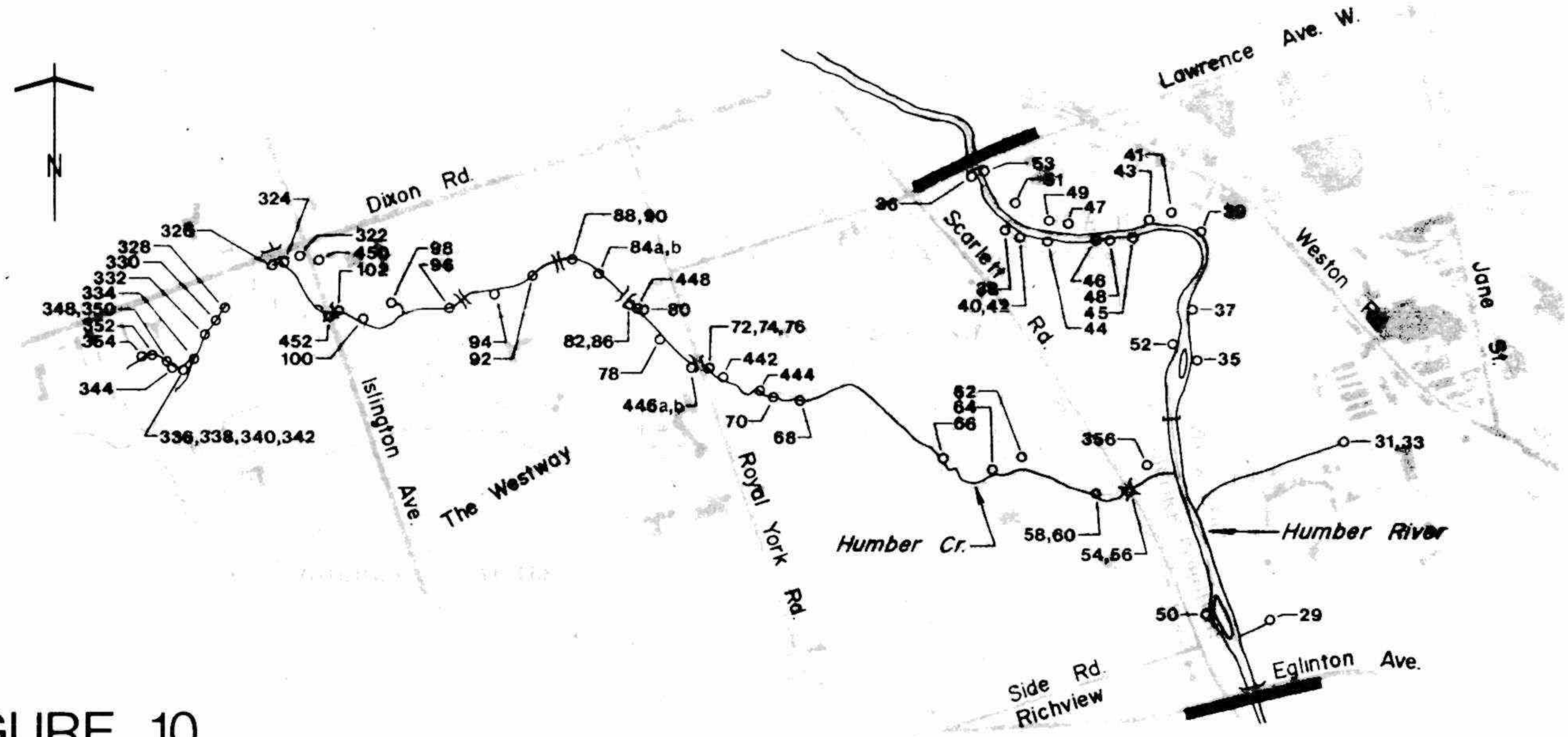

FIGURE 10

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach D

Scale 1:15,000
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Legend

○——100 **Outfall Location & Identification**

Weir

Bridge

Reach Boundary

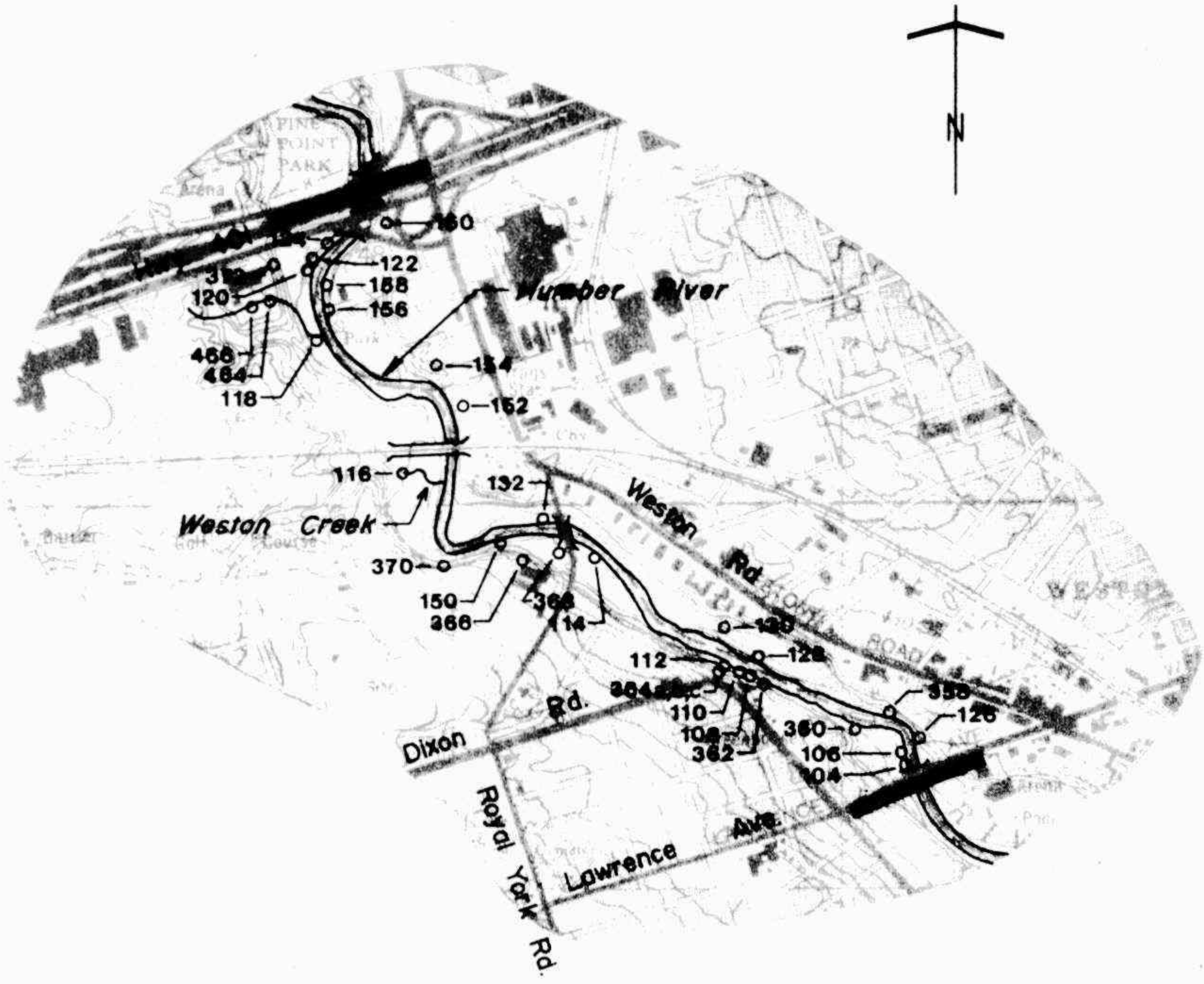

FIGURE 11

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach E

Legend

360 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1: 15,000

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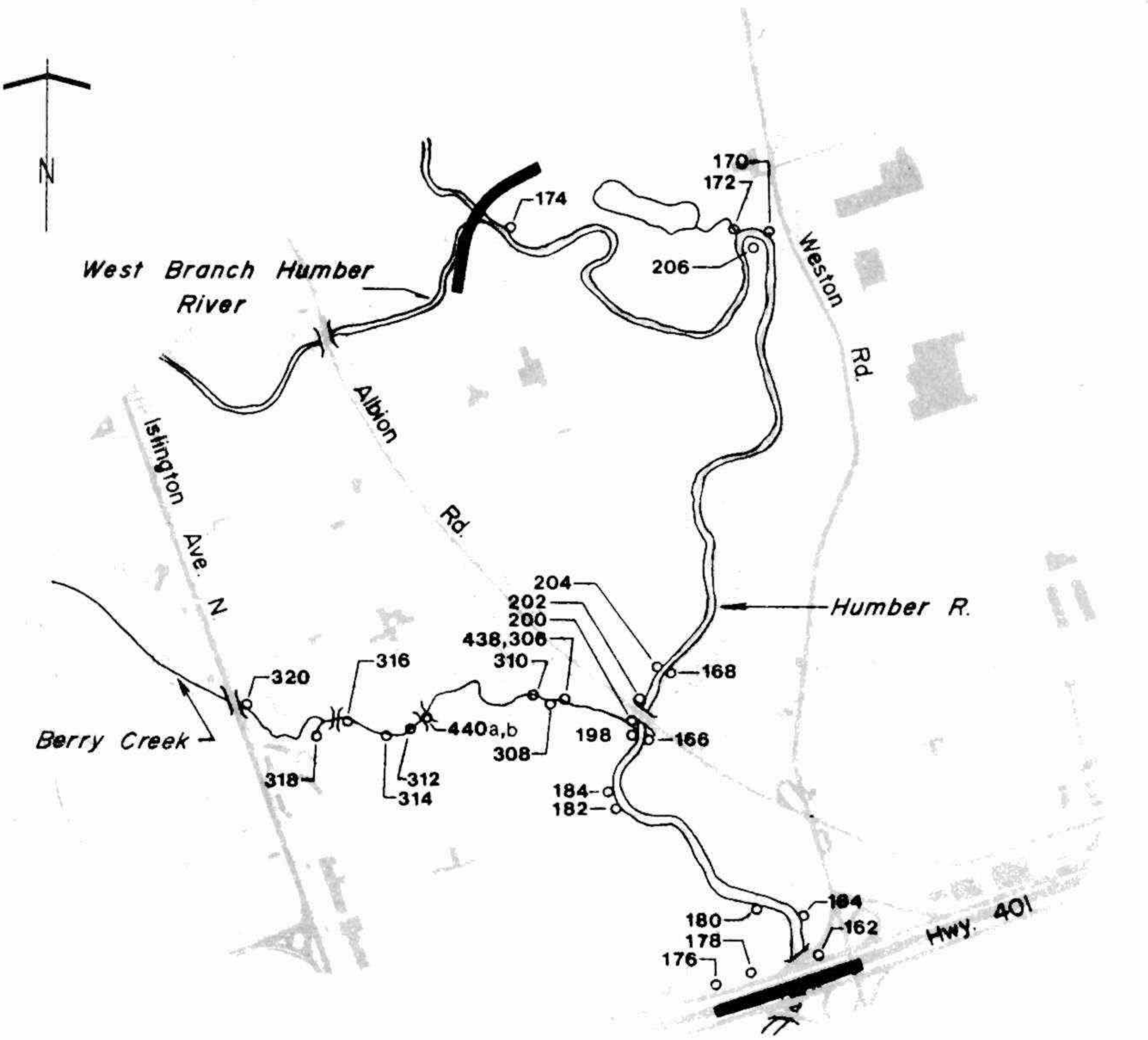

FIGURE 12

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach F

Legend

•——308 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1:15.000
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HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

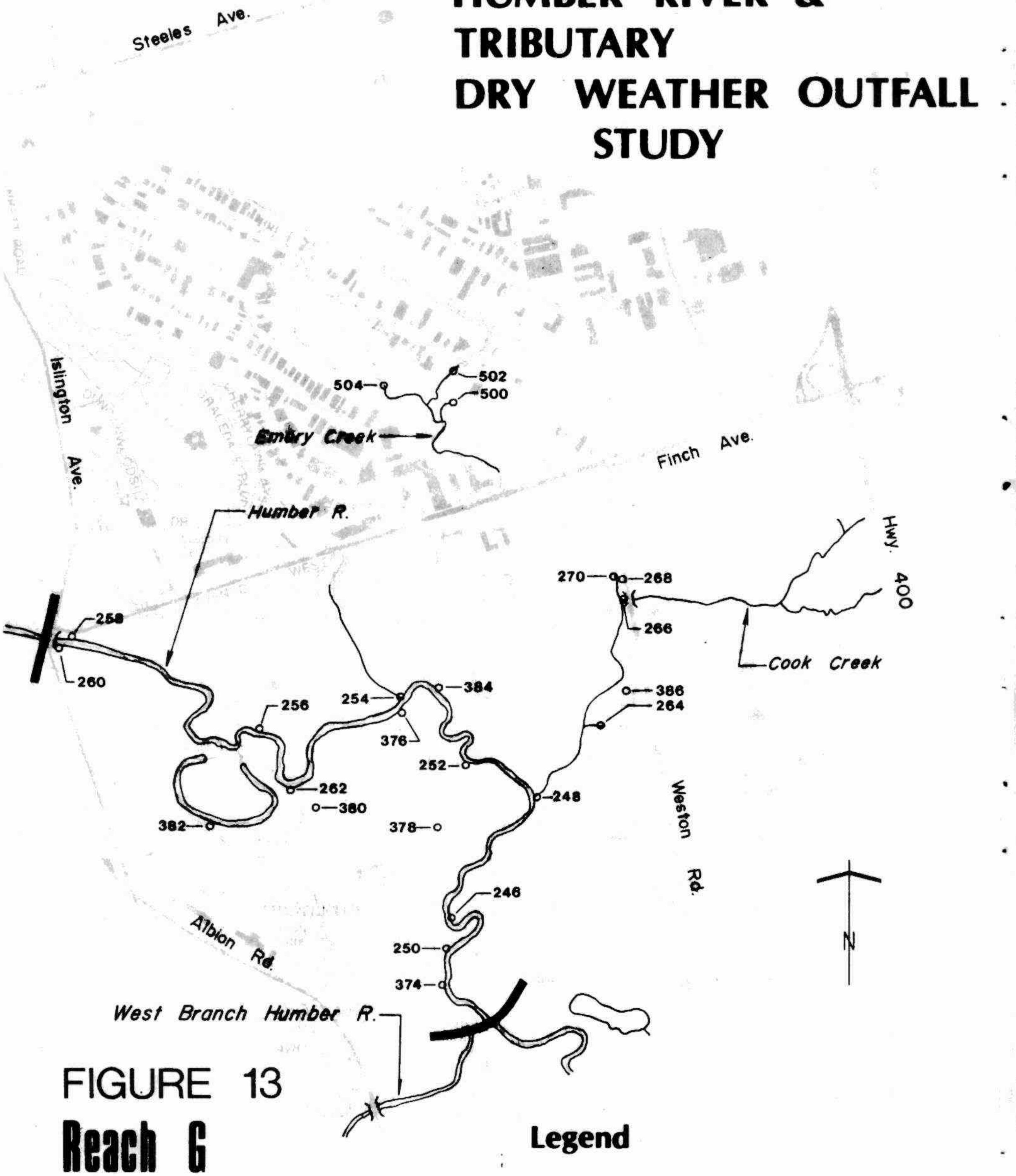

FIGURE 13
Reach G

Legend

o—— 250	Outfall Location & Identification
	Weir
	Bridge
	Reach Boundary

Scale 1:15,000
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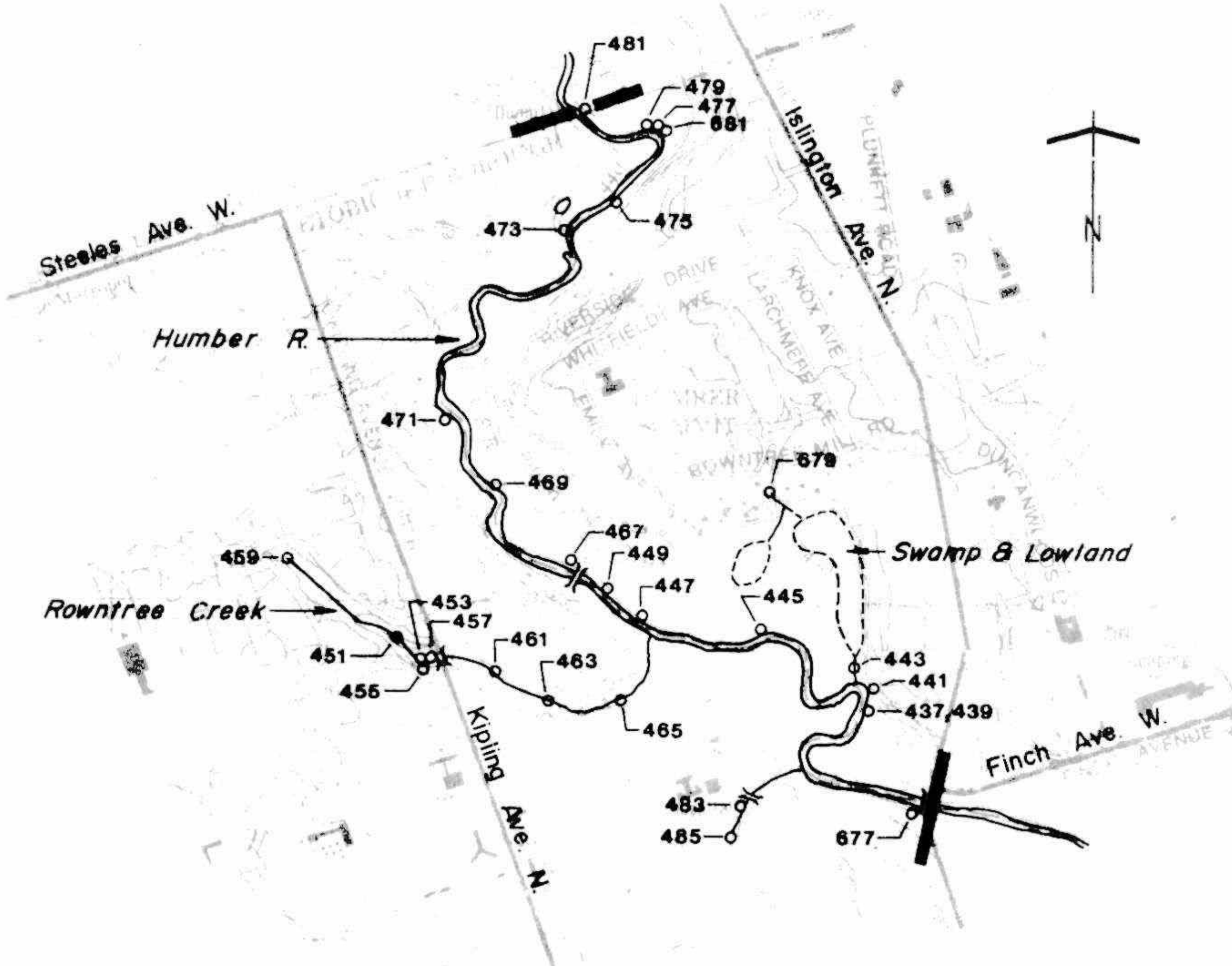

FIGURE 14
HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY
Reach H

Legend

o——677 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1: 15,000
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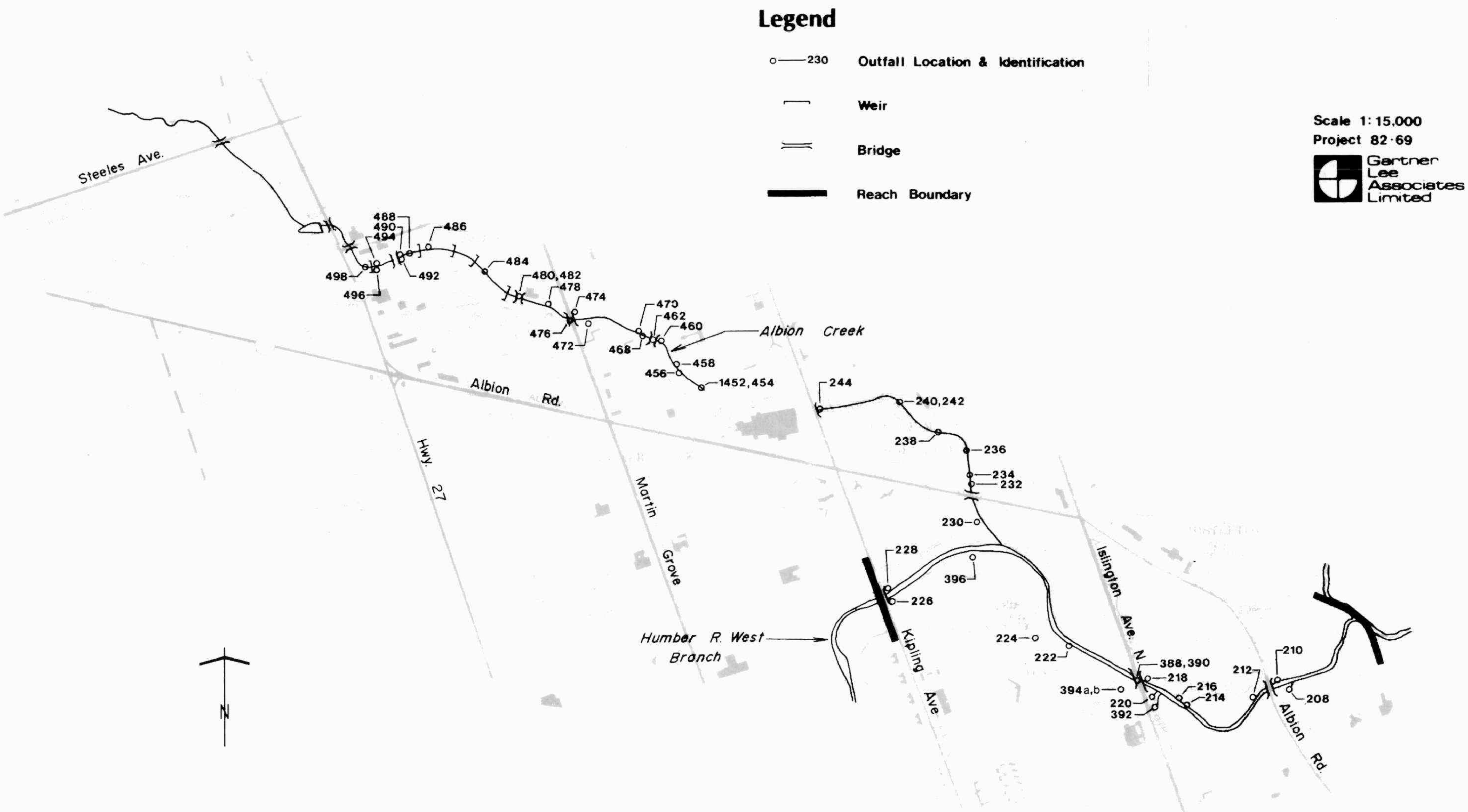
HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

FIGURE 15

Reach I



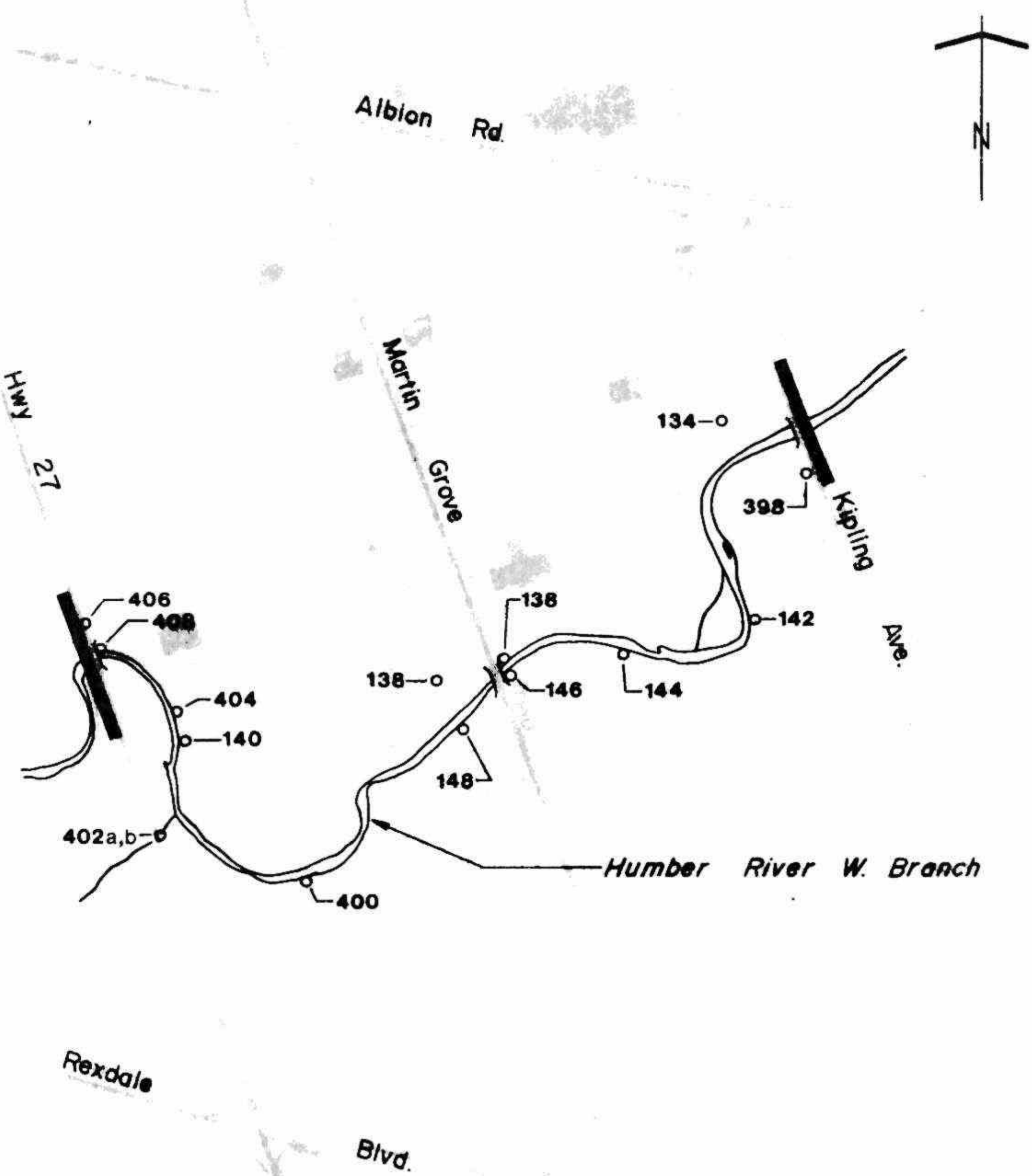


FIGURE 16

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach J

Legend

o—— 404 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1: 15,000
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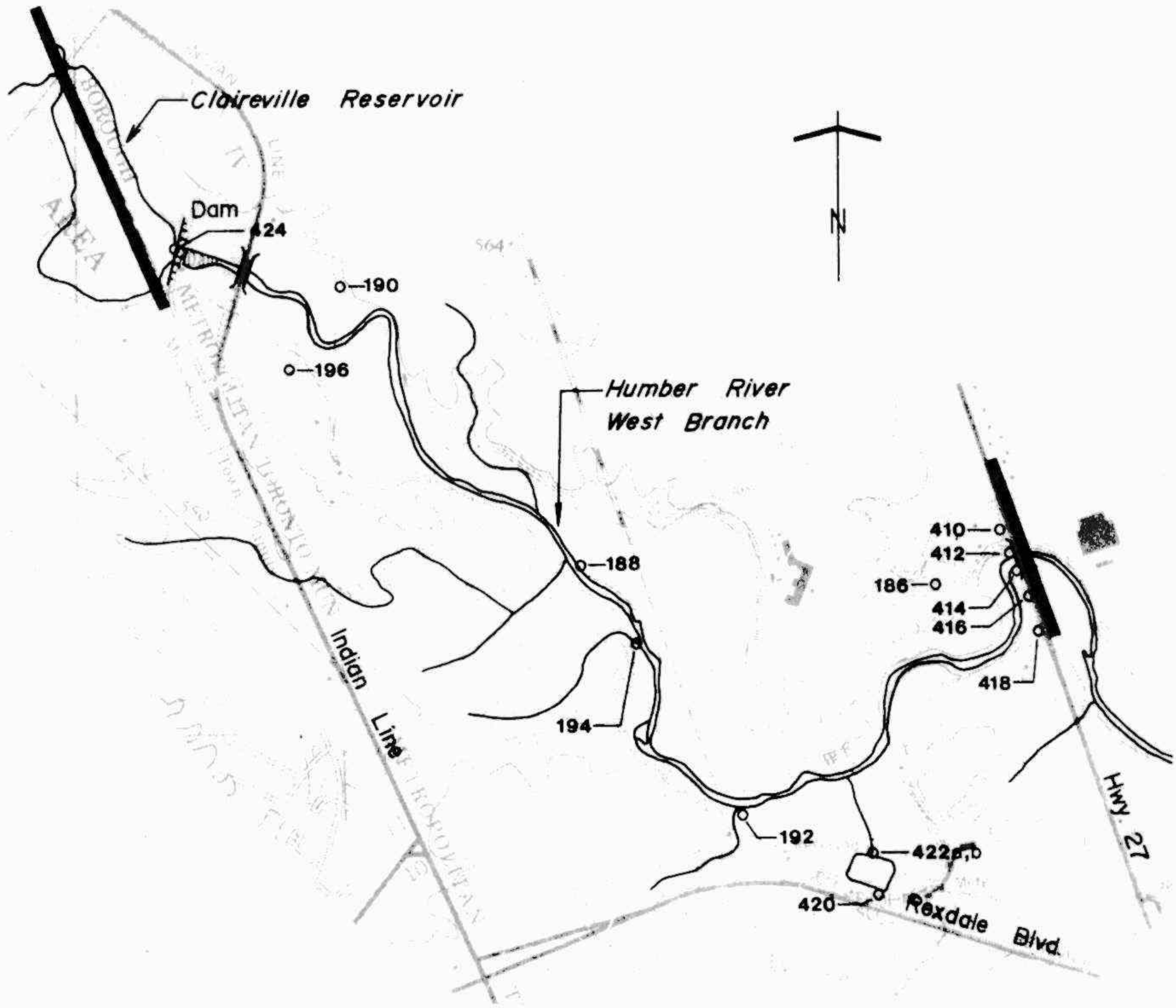


FIGURE 17

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach K

Legend

o—— 424 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1: 15,000

Project 82·69

Gartner Lee Associates Limited

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

FIGURE 18

Reach L

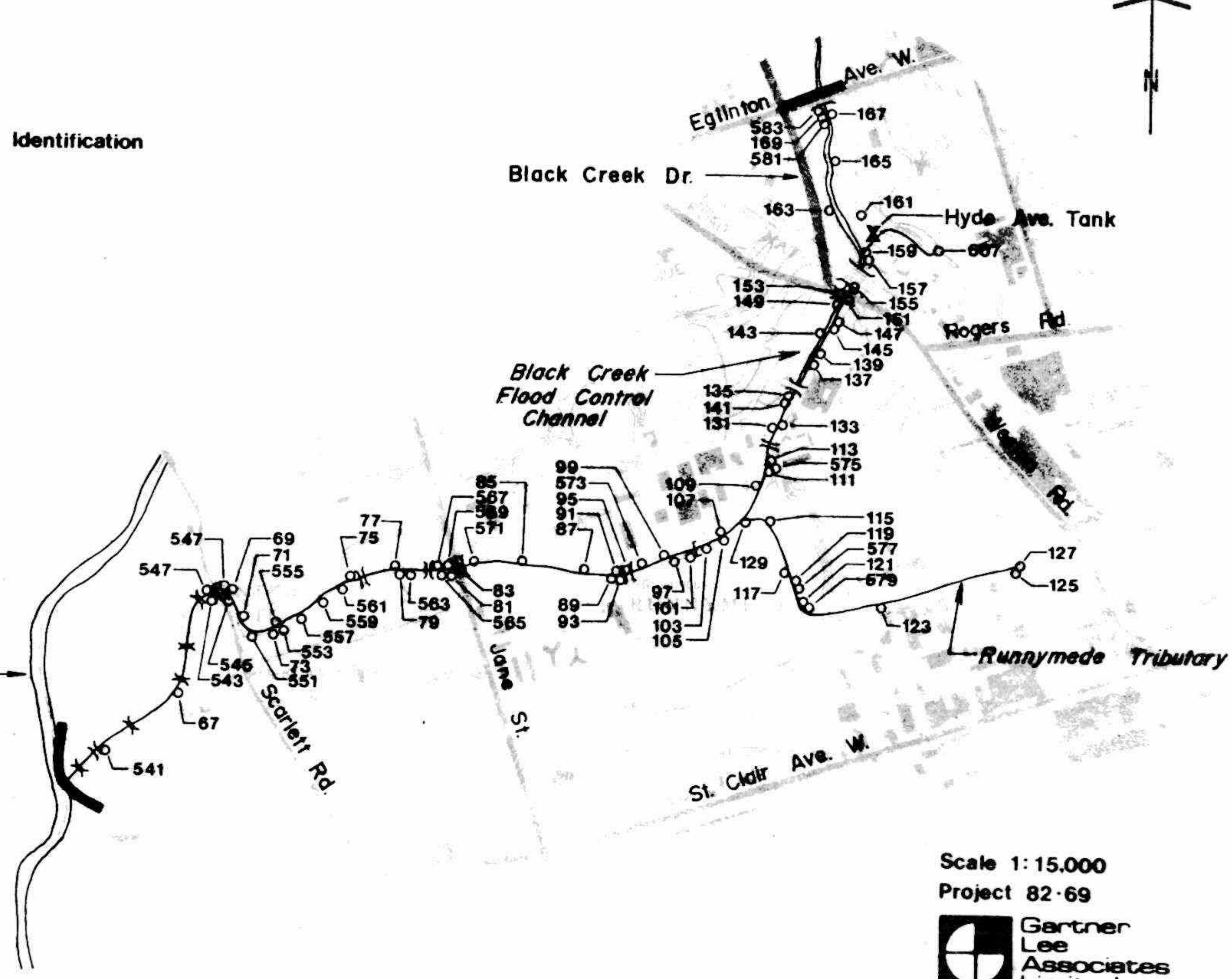
Legend

79 Outfall Location & Identification

Weir

Bridge

Reach Boundary



Scale 1: 15,000

Project 82-69

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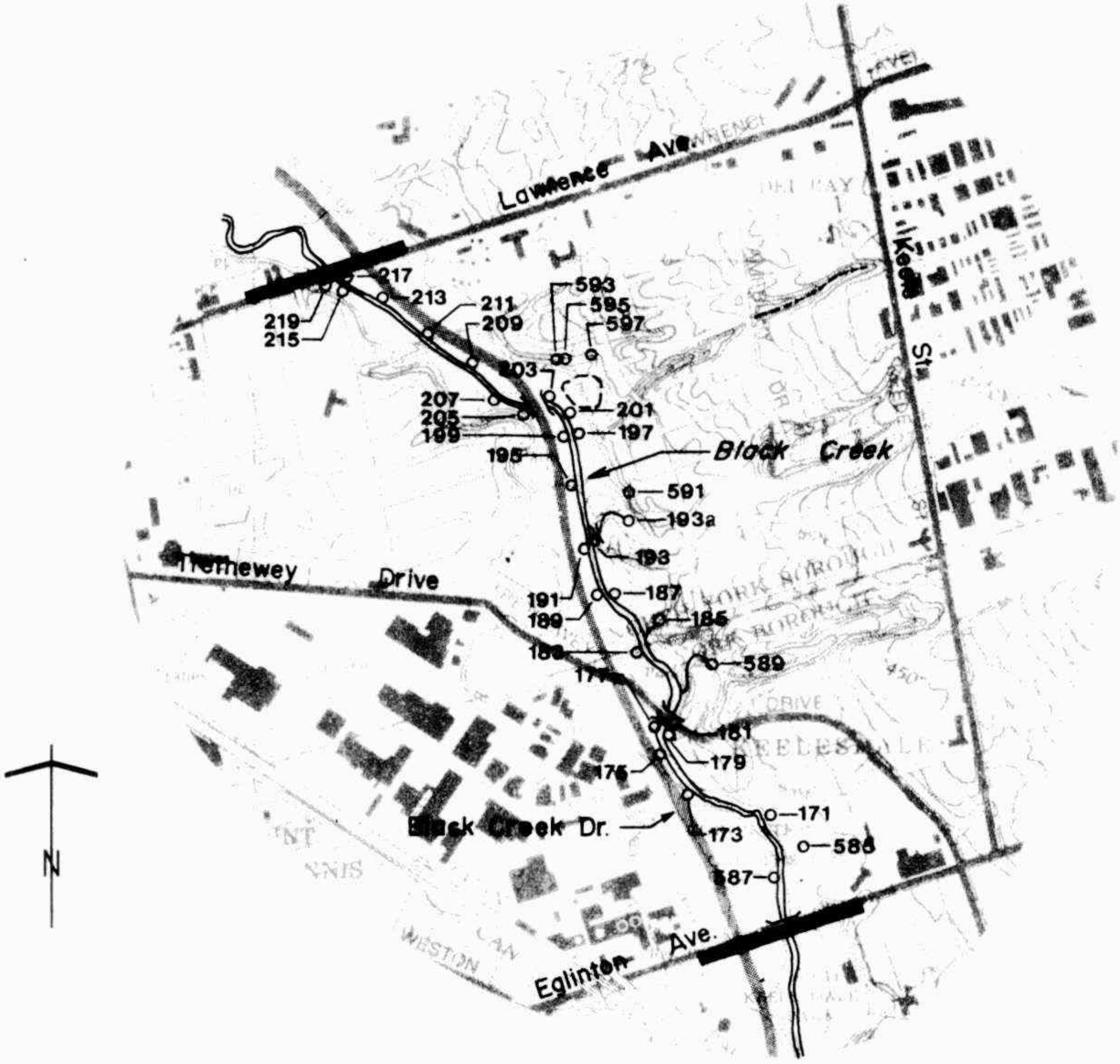

FIGURE 19

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach M

Legend

o——187 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1: 15,000

Project 82·69

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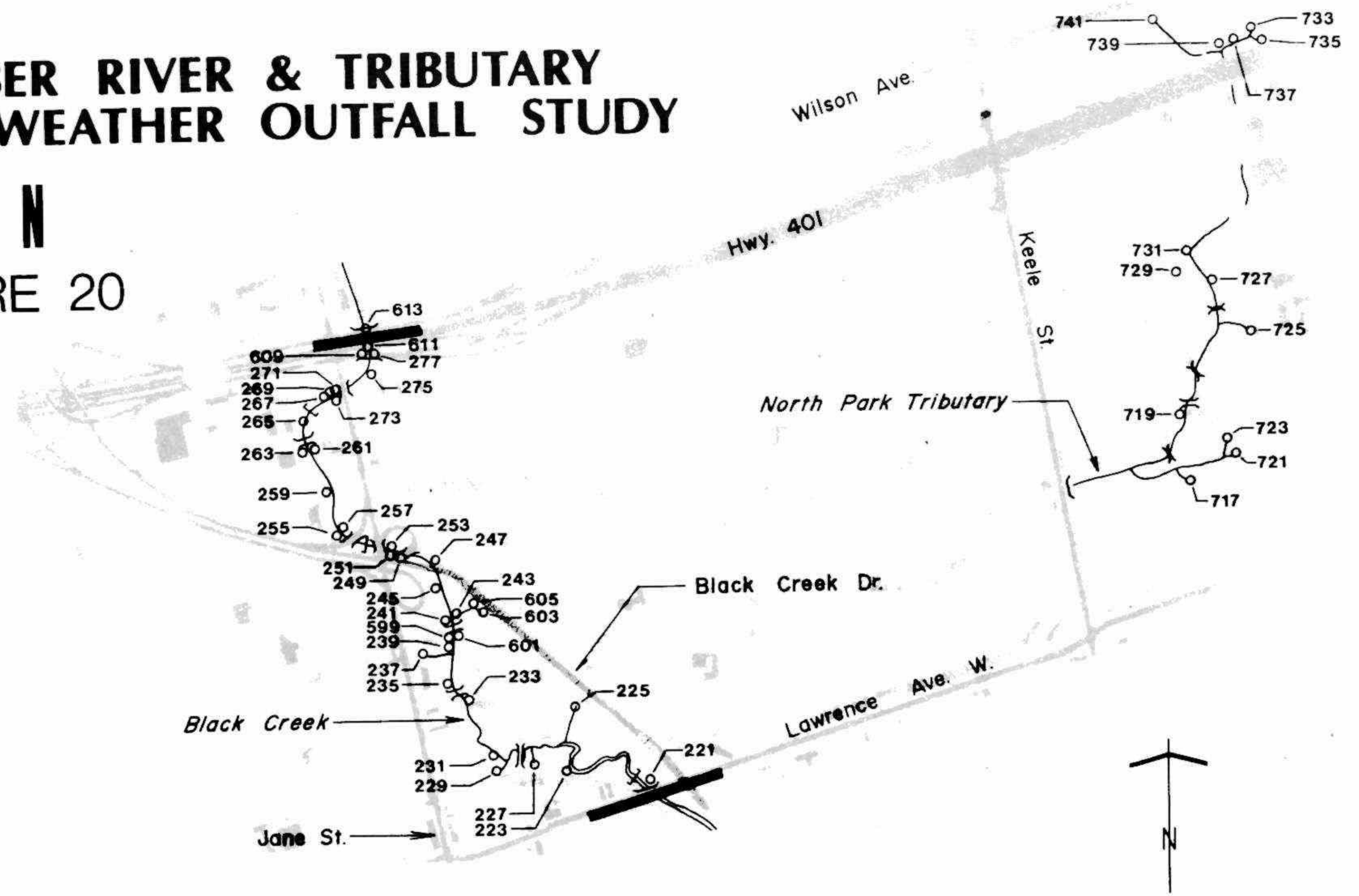
HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach N

FIGURE 20



Legend

o—— 263	Outfall Location & Identification
	Weir
	Bridge
	Reach Boundary

Scale 1: 15,000

Project 82·69

Gartner Lee Associates Limited

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach 0

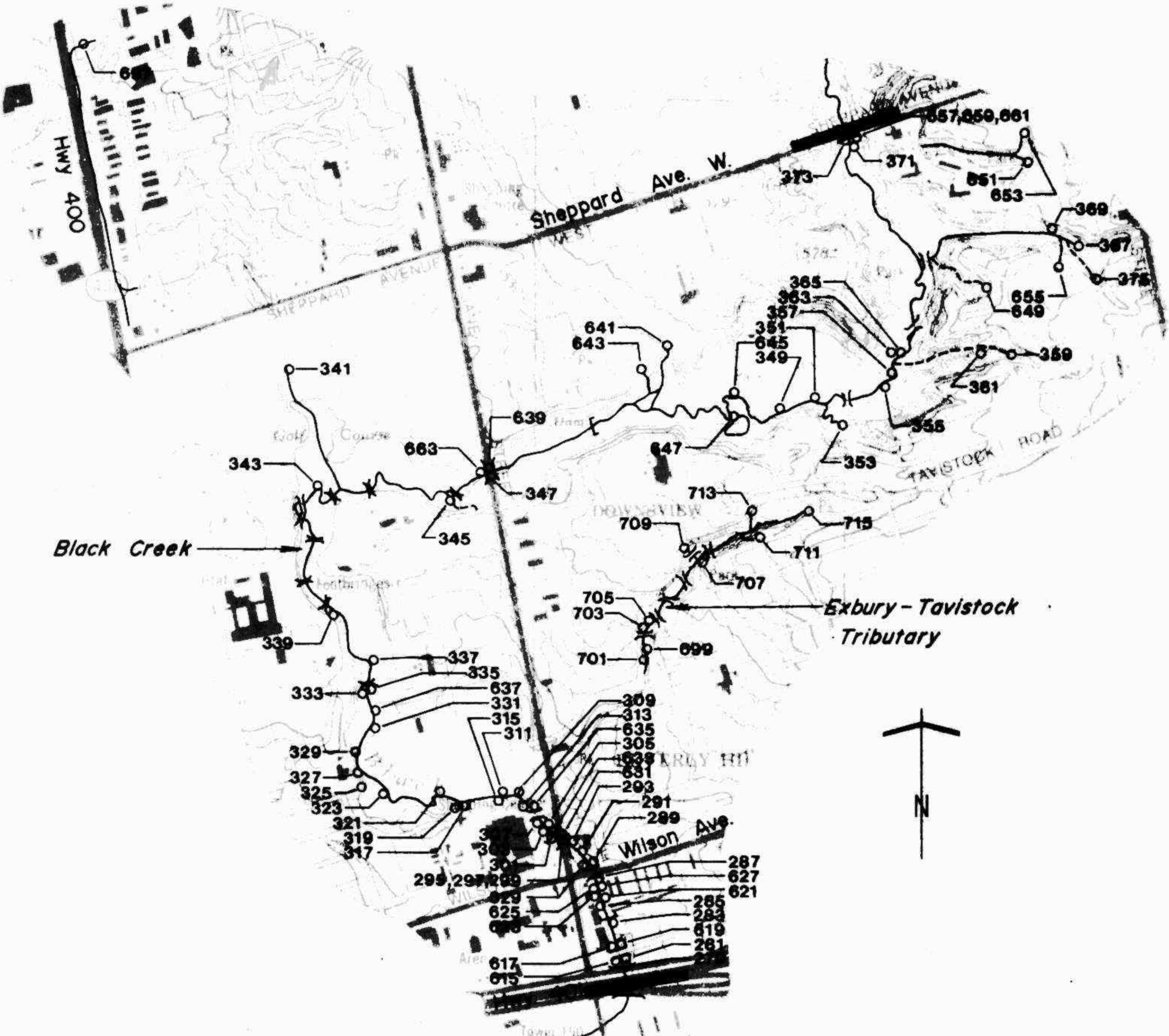


FIGURE 21

Legend

○——697 Outfall Location & Identification

Weir

Bridge

Reach Boundary

Scale 1: 15,000

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HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach P

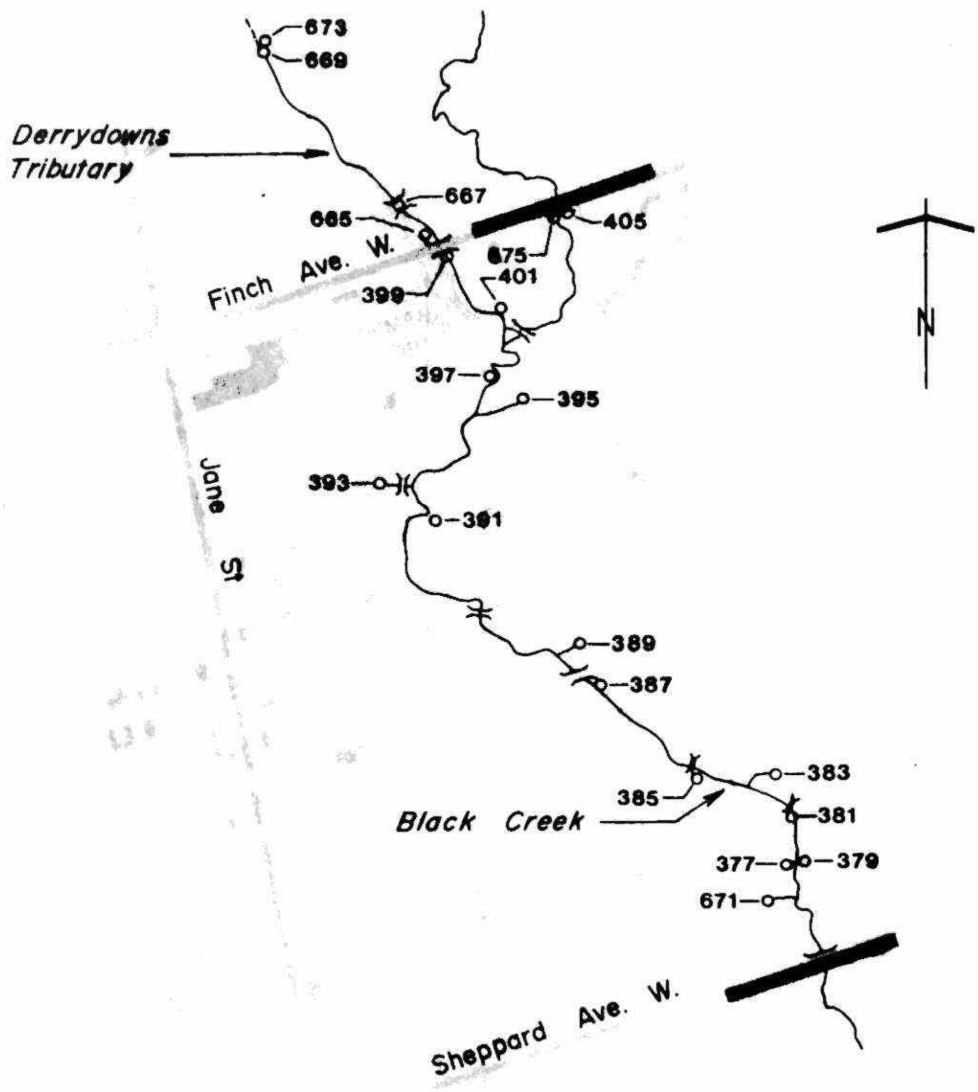
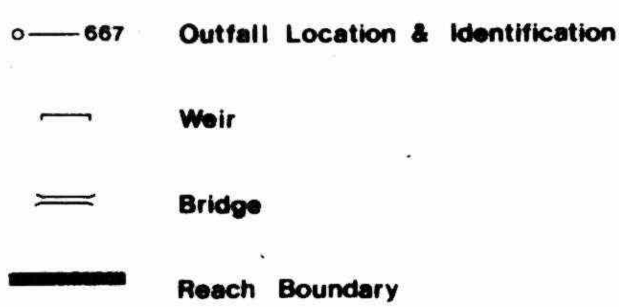


FIGURE 22

Legend



Scale 1: 15,000

Project 82·69

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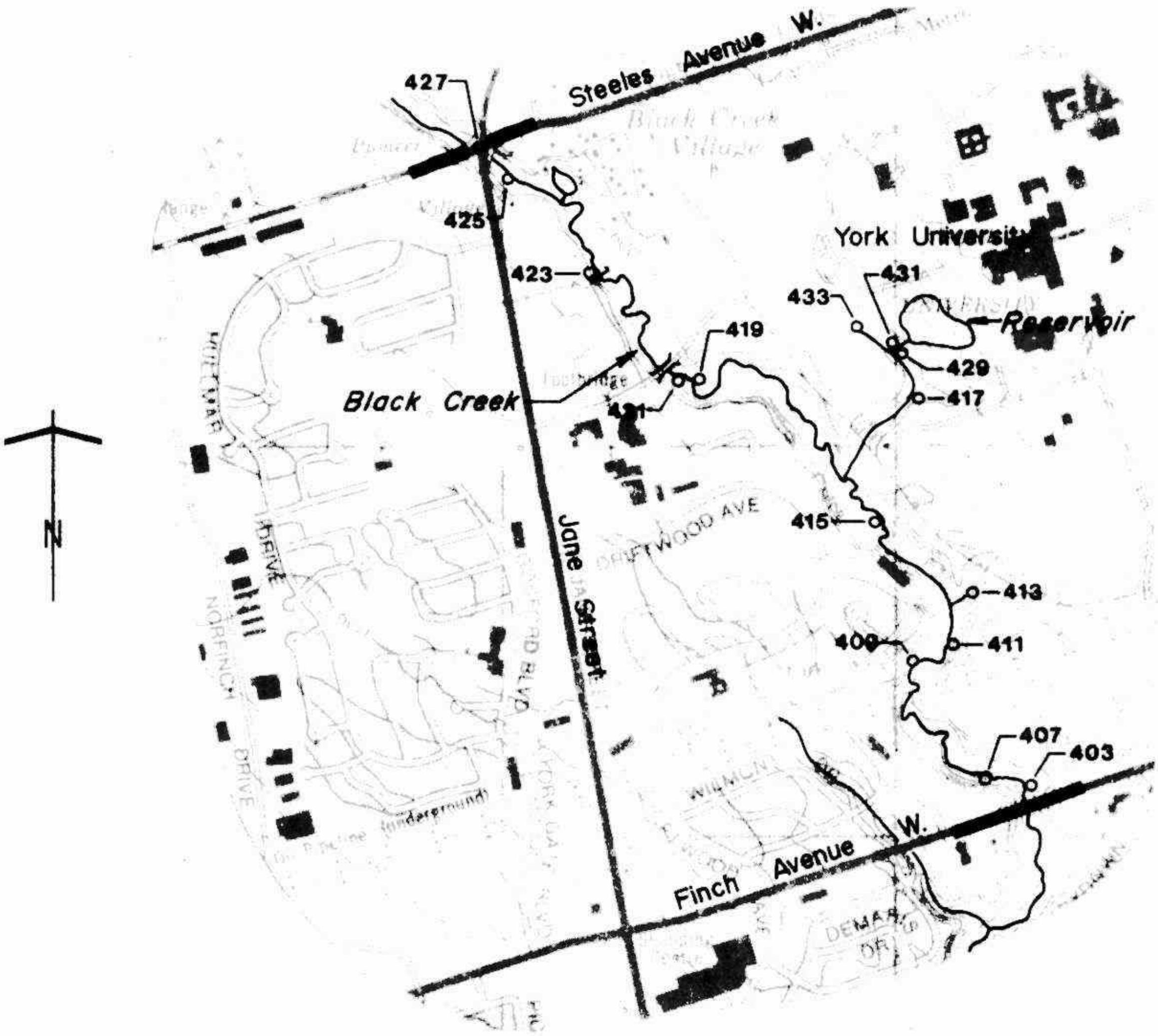

FIGURE 23

HUMBER RIVER & TRIBUTARY DRY WEATHER OUTFALL STUDY

Reach Q

Legend

o——427	Outfall Location & Identification
	Weir
	Bridge
	Reach Boundary

Scale 1:15,000

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unreliable owing to mechanical difficulties with the meter. Conductivity was found to be a reliable and quick field indicator of general contamination with levels ranging from 25 to 100,000 μmhos/cm.

Of the 366 actively flowing outfalls, 239 were sampled during the screening runs based on appearance, odour and/or in-field determination of chemical quality. Eighty-four (84) were considered sufficiently contaminated to warrant intensive sampling based on more detailed laboratory analysis. One hundred and twenty-seven outfalls were not sampled because of insufficient depth of flow, eg. shallow sheet flow over a wide apron, or because the outfall could not be accessed safely. No sampling was undertaken in manholes.

In summary,

- 624 outfalls were mapped;
- 366 (58%) were active under dry weather conditions;
- 239 (38%) were sampled during screening runs;
- 127 (20%) active outfalls were not sampled because of insufficient discharge or accessibility problems; and
- 84 (13%) outfalls were judged contaminated enough to justify intensive sampling.

4.0 IDENTIFICATION OF PRIORITY OUTFALLS:

Priority outfalls were identified in two ways:

- by assessing relative chemical loadings to the Humber River watershed within Metropolitan Toronto from each outfall producing a dry weather discharge; and

- by comparing geometric mean levels of bacteria among outfalls producing dry weather flow.

4.1 CHEMICAL LOADINGS:

The average dry weather contaminant loading for chemical parameters for each active outfall is provided in Appendix A, Table A3 (Outfall Loading Sheets). Table A3 warrants brief explanation to aid in interpretation of data arising from analytical results which were expressed as "less than the analytical detection limit" for a particular parameter.

Values written in Gothic script were calculated from parameter mean concentrations that were measurable with the analytical techniques applied. Values written in *Italic* script were calculated from parameter concentrations assumed to be equal to the detection limit for that parameter. The *italicized* loadings represent a maximum possible loading which could result from a parameter which is present at a concentration below,

but close to the analytical detection limit of the parameter.

In Table A3 of Appendix A, total loadings for each parameter have been aggregated for all of the outfalls in a particular reach. One total (Total A) has been calculated from measurable mean concentrations; the other (*Total B*), has been calculated incorporating the detection limit values and provides an estimate of the upper limit of the load that is possible for that parameter within a reach. For example, in Reach A, for Lead, the total loading (Total A) is given as 5.2 g/d , with the upper limit of the "low concentration" loading (*Total B*) being an additional 157 g/d . These totals can be interpreted as showing that the lead load from outfalls in Reach A is between 5.2 g/d and 172 g/d . Similarly the loading of soluble phosphorus could range from 145 g/d to 171 g/d . (Appendix A, Table A3 A, page 3). Total B is provided for the reader's interpretation and will not be used in subsequent summaries or interpretation in this report. However, the possibility of an additional load originating from parameters expressed in "less than detectible" concentrations must be recognized. *Total B* could be used to "fine-tune" contaminant budgets if required.

4.1.1 GENERAL:

The measured total loadings for each reach are listed by parameter in Table 6. This table shows the total loadings from outfalls within each reach, the total loading from outfalls within the study area, the loadings from Humber River, West Branch of the Humber River and Black Creek, as well as a Grand Total being

TABLE 6: SUMMARY OF DRY WEATHER CONTAMINANT LOADING FROM OUTFALLS BY REACH

Reach / Parameter	Average Contaminant Loading (g/day)						
	A	B	C	D	E	F	G
TKN	1920.5	2085	3165.4	1311.7	1593.5	244	6679
NH_3-N	506.9	537.6	283.3	252	908.1		2058
NO_2-N	44.2	5.8	0.3	13.4	15.7		465
NO_3-N	442.4	1119.7	33.26	352	314		2974
Phosphorus - Total	245.1	299.7	491.8	3450	349.3	186.1	5119
Phosphorus - Soluble	121.9	126.8	183.7	1231	59.9	55.7	2143
BOD	6067.8	29237	13513.5	9323.1	5938	8146	42874
COD	23499	198952	50582	34686	27641	15483	491176
Phenolics (mg/day)	1.08	1.71	2.64	41.6	0.77	3.88	117.68
Suspended Solids	12296	89192	73285.8	11184	10962	3229	739667
VSS (%)	28.2%	70.5%					
Lead	5.2	13.3		2.24	14.69	0.08	880.2
Copper		102.6	0.58	5.64	3.17		116.0
Chromium		16.3		436.6			2937.4
Iron	924.9	1346.4	3664.3	544.7	292.0	395.2	18994
Zinc	1420.1	52.4	46.3	97.9	54.1	56.7	8524.1
Mercury	0.83		0.53	0.95			

TABLE 6: (CONT'D)

Parameter \ Reach	Average Contaminant Loading (g/day)						
	H	I	J	K	L	M	N
TKN	995	1470	440.7	319	16494	6425	5026
NH_3-N	101.1	777.8			9305	2855	1319
NO_2-N		43.8			180.13	189.6	111.9
NO_3-N	6	1076			461	3328	1551
Phosphorus - Total	1724.5	196.2	470.1	38.5	2394.4	710.4	606.5
Phosphorus - Soluble	1563.2	41.8	73.8	15.55	1471.5	151.6	202.2
BOD	6385	2795	3342	3374	72515	28709	39674
COD	17980	17446	6480	18390	200482	86100	388945
Phenolics (mg/day)	1.21				9.4	7.69	47.50
Suspended Solids	22609	22588	3915	5899	216629	43157	344473
VSS (%)					39.9%	30.1%	35.7%
Lead					5.32	187.3	210.7
Copper	6.18		3.47		67.34		56.9
Chromium			66.25		1.56		
Iron	355.1	770.2	739.9		3518	4099.2	8012
Zinc	330.7	25.58	36.9		884.7	151.5	208.5
Mercury			28.31		18.81	0.98	0.39

TABLE 6: (CONT'D)

Parameter \ Reach	Average Contaminant Loading (g/day)						
	O	P	Q				
TKN	5586	4576	635.9				
NH_3-N	505.6	1568.1					
NO_2-N	13.0	98.5					
NO_3-N	703	2565					
Phosphorus - Total	3481.8	791.6	174.0				
Phosphorus - Soluble	1895.1	427.6	39.6				
BOD	39207.9	36276	3576				
COD	126266	82081	13216				
Phenolics (mg/day)	43.71	2.71	0.09				
Suspended Solids	44247	31661	6173				
VSS (%)	71.7%						
Lead	69.9	75.10					
Copper	7.6						
Chromium	9.5		125.3				
Iron	1468.7	1100.9	156.6				
Zinc	232.8	190.1	17.81				
Mercury		21.55					

TABLE 6 (CONT'D)

Reach / Parameter	Average Contaminant Loading (g/day)						
	TOTAL (outfalls)		(EXTERNAL SOURCES - RIVERS)			GRAND TOTAL	
			(WBHR)	(HR)	(BC)		
TKN	58967			21963	16070	97000	
NH_3-N	20977					20977	
NO_2-N	1178.3					1178.3	
NO_3-N	14926					14926	
Phosphorus - Total	20729		905.5(A)	26356	1607	49597.5 13458	
Phosphorus - Soluble	10945		905.5		1607	13458	
BOD	350950		67910	439258	80352	938470	
COD	1799405		588557	2635545	535680	5559187	
Fecal Coliforms							
Fecal Strepto-cocci (count/100 ml)							
Phenolics mg/day	281.67					281.67	
Suspended Solids	1681167		2082586	878515	107136	4749404	
VSS (%)	39.7					39.7	
Lead	1464.0					1464.0	
Copper	369.5					369.5	
Chromium	3592.9					3592.9	
Iron	46382		56592	39533	5624.6	148132	
Zinc	12330			19767	538.4	32636	
Mercury	72.35					72.35	

(A) = Approximately

the loading from all sources. Table 7 further summarizes these data to facilitate comparison of the total mean daily dry weather loadings from outfalls for each contaminant with external loads from streams entering the study area.

These tables show that generally, the total dry weather outfall loadings of BOD, COD, total phosphorus, suspended solids and zinc are of the same order as those carried by streams flowing into the study area. However, outfalls within the study area contribute significantly more nitrogen (TKN, NH_3, NO_3), phenolics, lead, copper, chromium and mercury than water entering the study area from upstream.

Figures 24 through 36 are bar graphs plotting dry weather load in each study reach for each parameter. These figures graphically illustrate data contained in Table 6. By glancing at these figures, it can be quickly seen that Reach L appears to contribute a major proportion of the dry weather nutrient and organic load to the study area. Reach G is the major source of phenols, suspended solids and metals although other reaches also contribute significant amounts of some of the individual metal parameters.

4.1.2 PRIORITY OUTFALLS:

As stated earlier, priority outfalls were identified in part by determining their relative contribution to the overall loading to the study area of each chemical parameter. For purposes of this study, outfalls were partitioned into three categories according to their

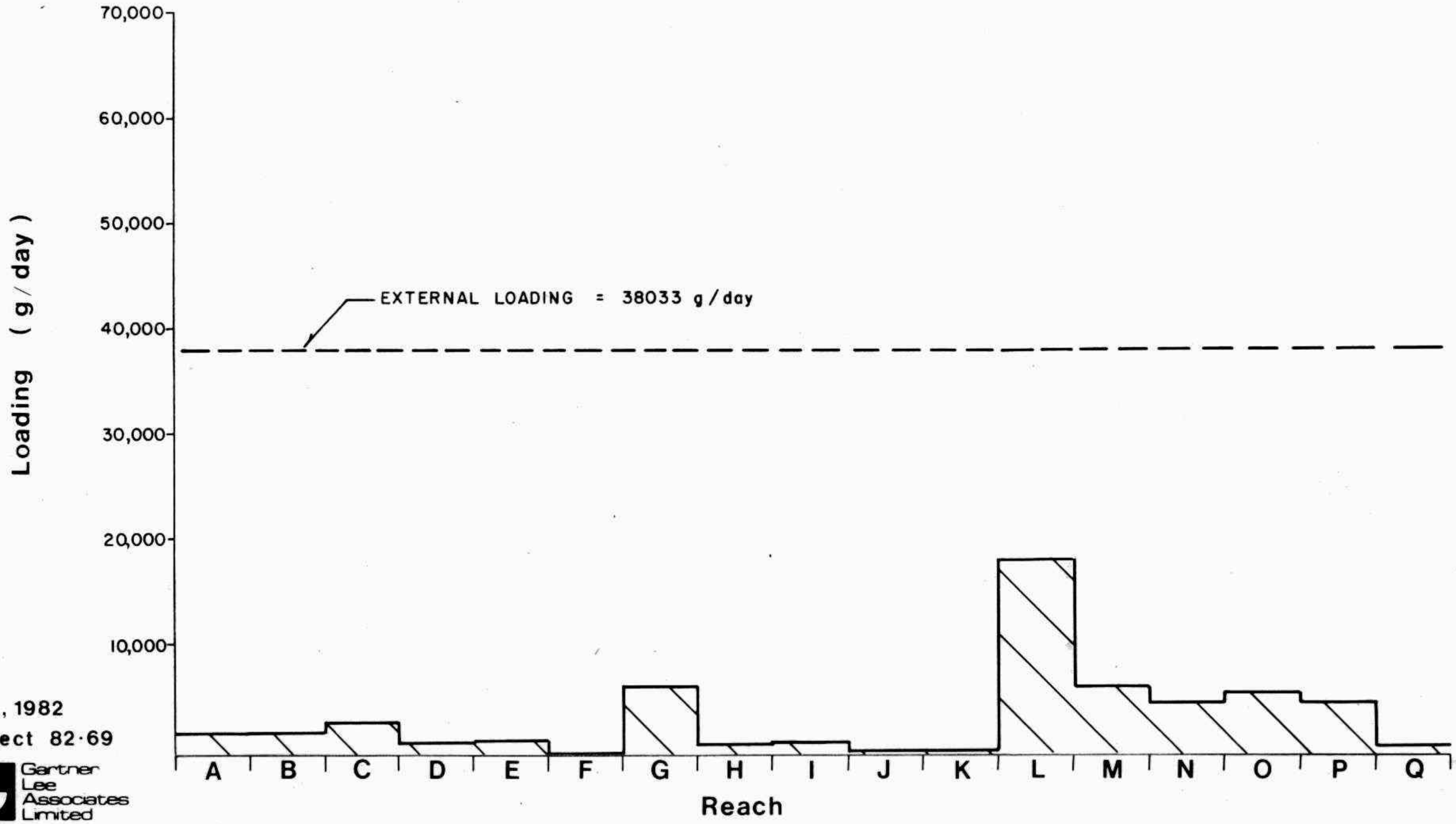
TABLE 7: COMPARISON OF DAILY DRY WEATHER STORM SEWER LOAD WITH DAILY LOADS IN STREAMS ENTERING THE HUMBER BASIN STUDY AREA - FALL, 1982 (LOADINGS IN KG/DAY)

PARAMETER	TOTAL OUTFALL LOADING	TOTAL EXTERNAL LOAD
TKN	59	38
NH_3	21	D.L.
NO_3	15	D.L.
TOTAL P	21	29
BOD	351	588
COD	1,800	3,760
PHENOL	0.3	D.L.
S.S.	1,681	3,068
PB	1.5	D.L.
CU	0.4	D.L.
CR	3.6	D.L.
ZN	12.3	20
HG	0.1	D.L.

D.L. THE CONCENTRATION OF THIS PARAMETER WAS BELOW THE RELEVANT DETECTION LIMIT.

FIGURE 24

DRY WEATHER LOADING OF TOTAL KJELDAHL NITROGEN FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH



Fall, 1982
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FIGURE 25

DRY WEATHER LOADING OF TOTAL AMMONIA FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH

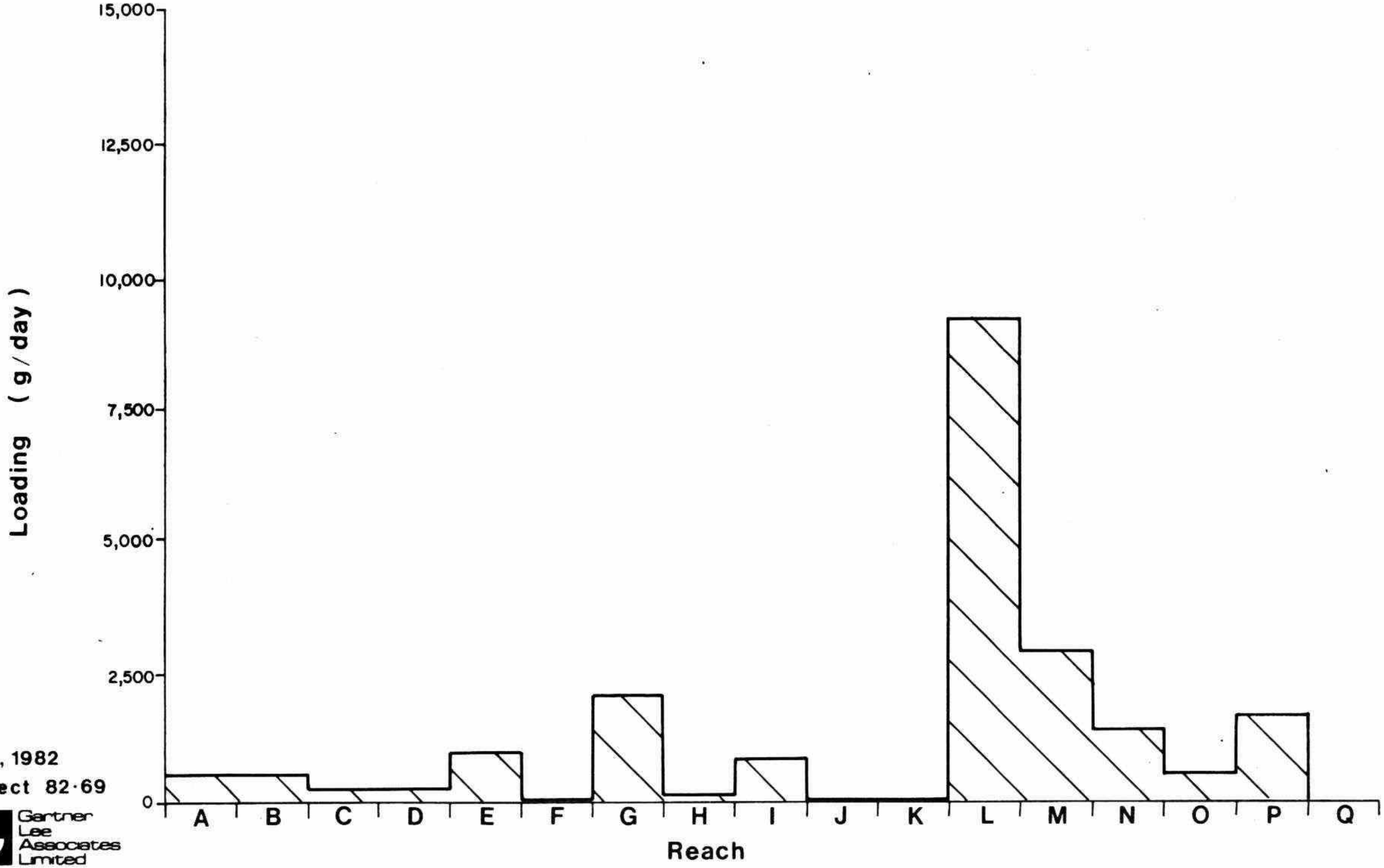

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FIGURE 26

DRY WEATHER LOADING OF TOTAL PHOSPHOROUS FROM OUTFALLS TO HUMBER RIVER SYSTEM FALL, 1982

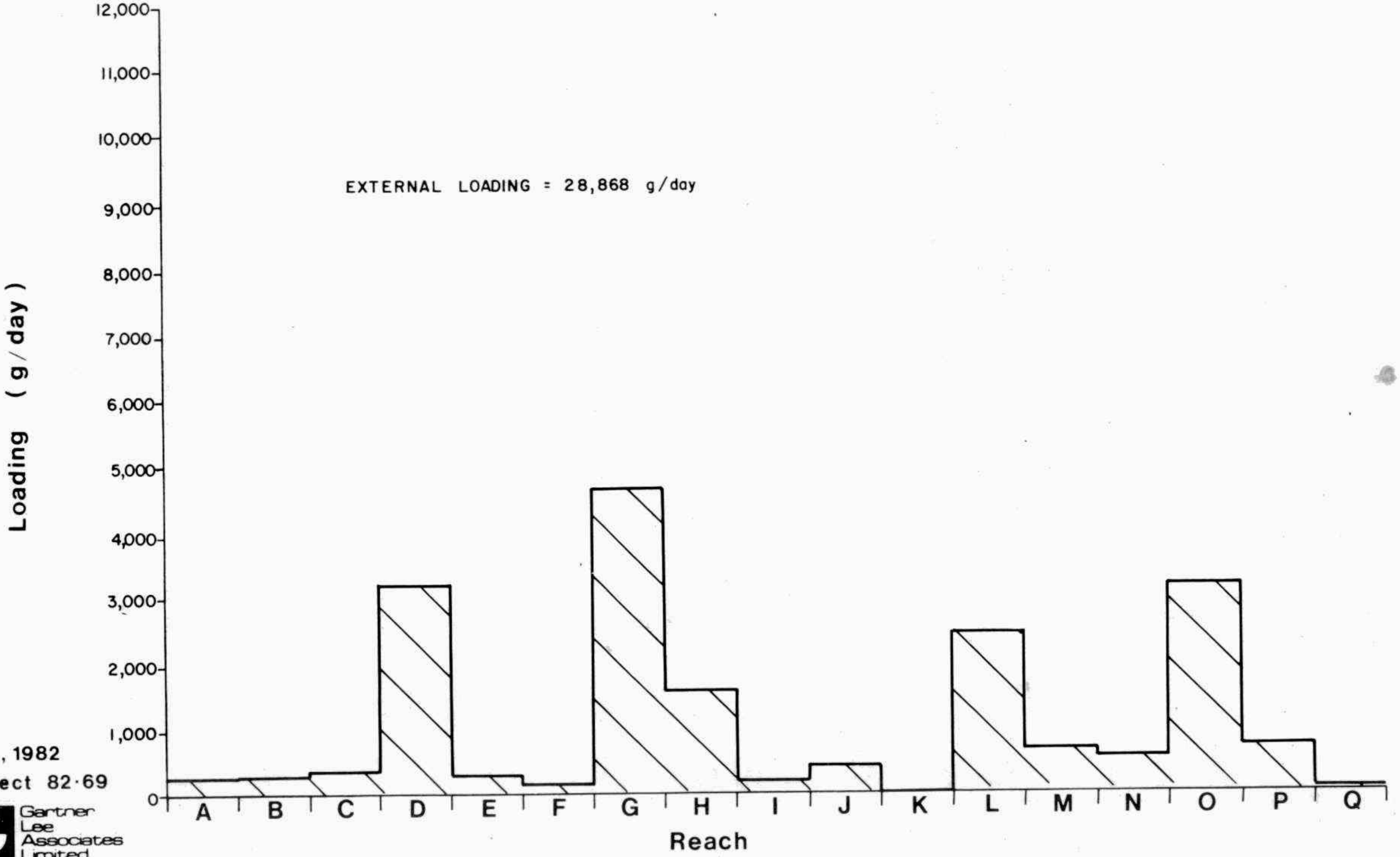

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FIGURE 27

DRY WEATHER LOADING OF TOTAL BOD FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH

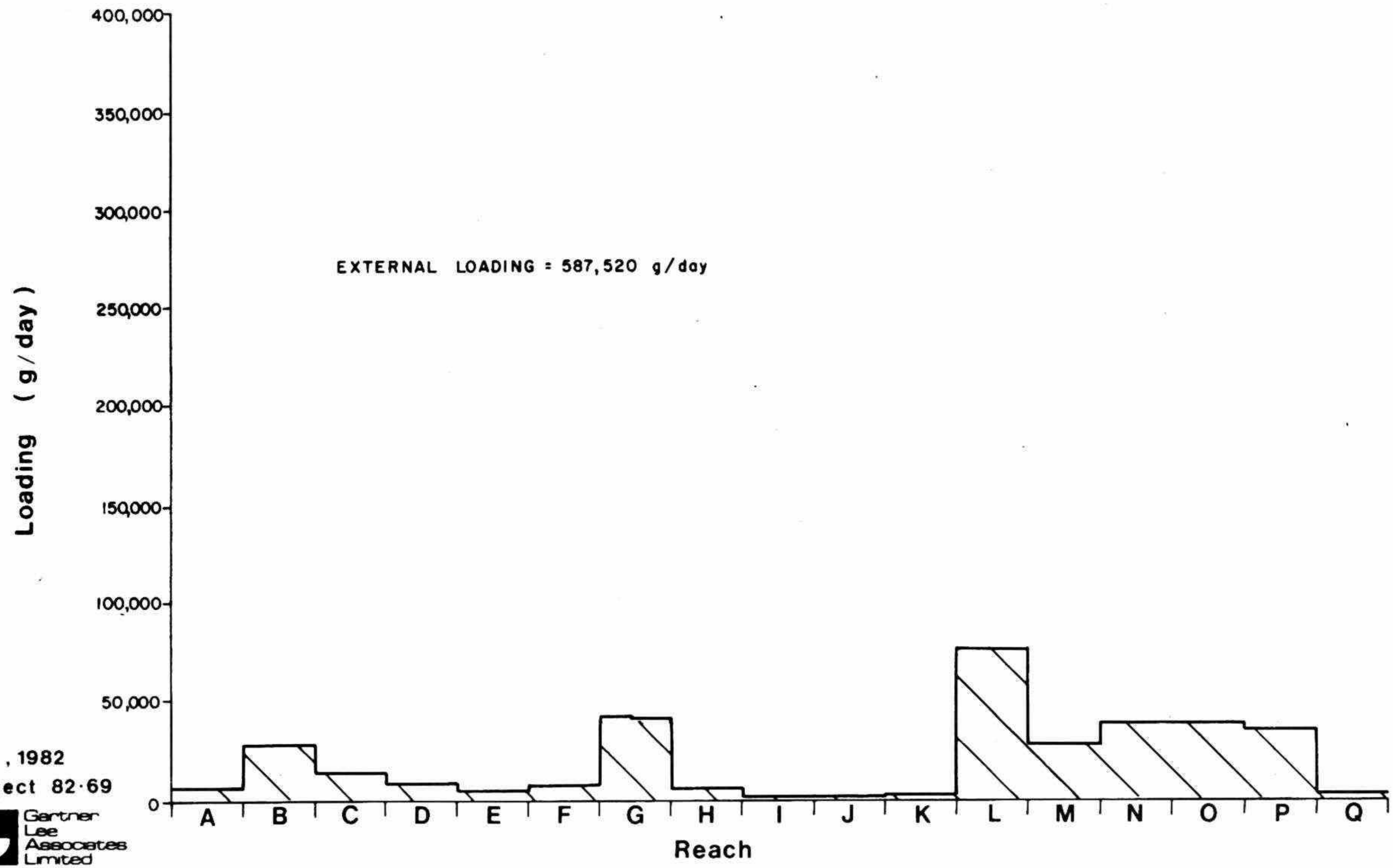

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FIGURE 28

DRY WEATHER LOADING OF CHEMICAL OXYGEN DEMAND FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH

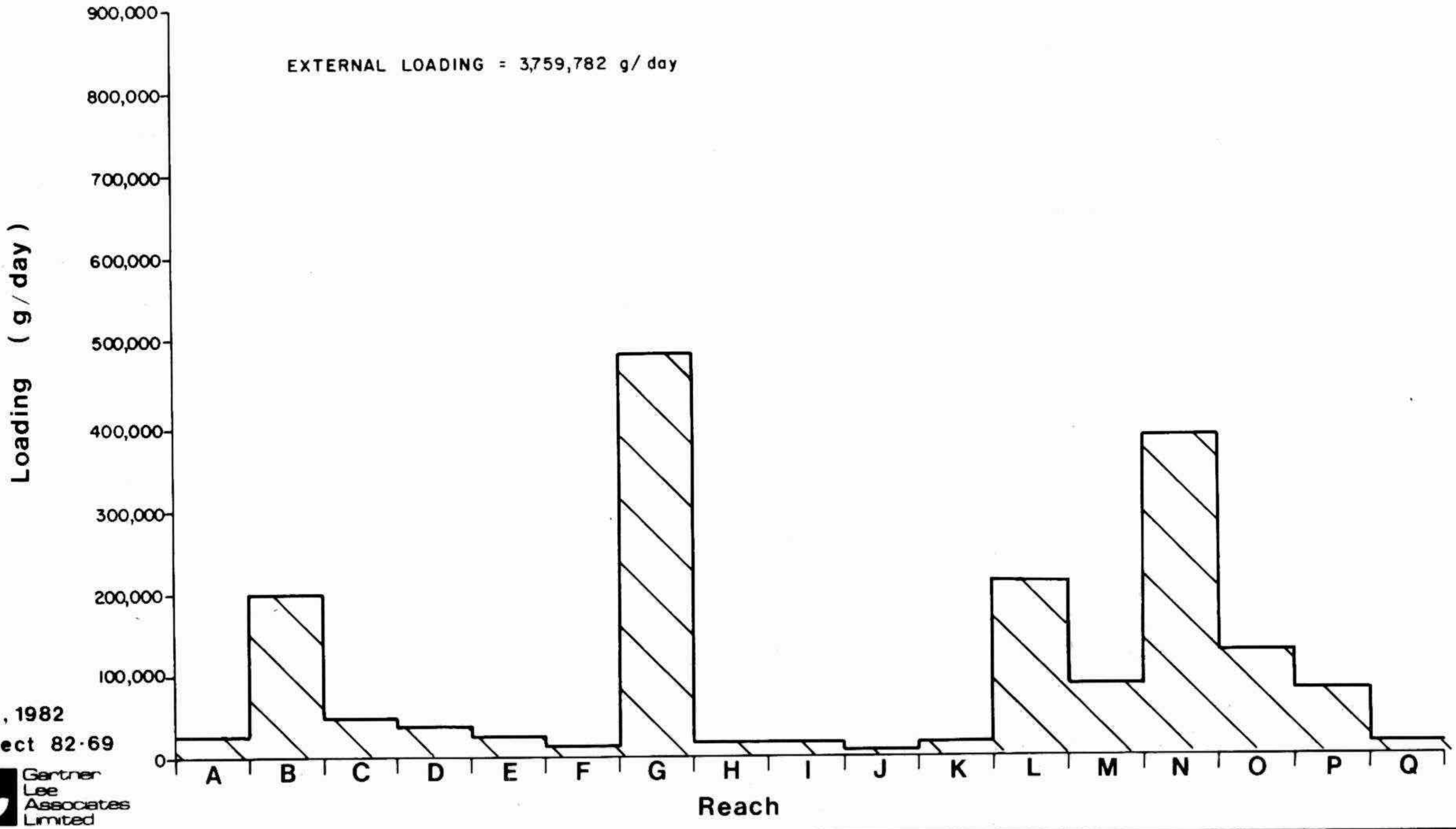

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FIGURE 29

DRY WEATHER LOADING OF PHENOLICS FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH

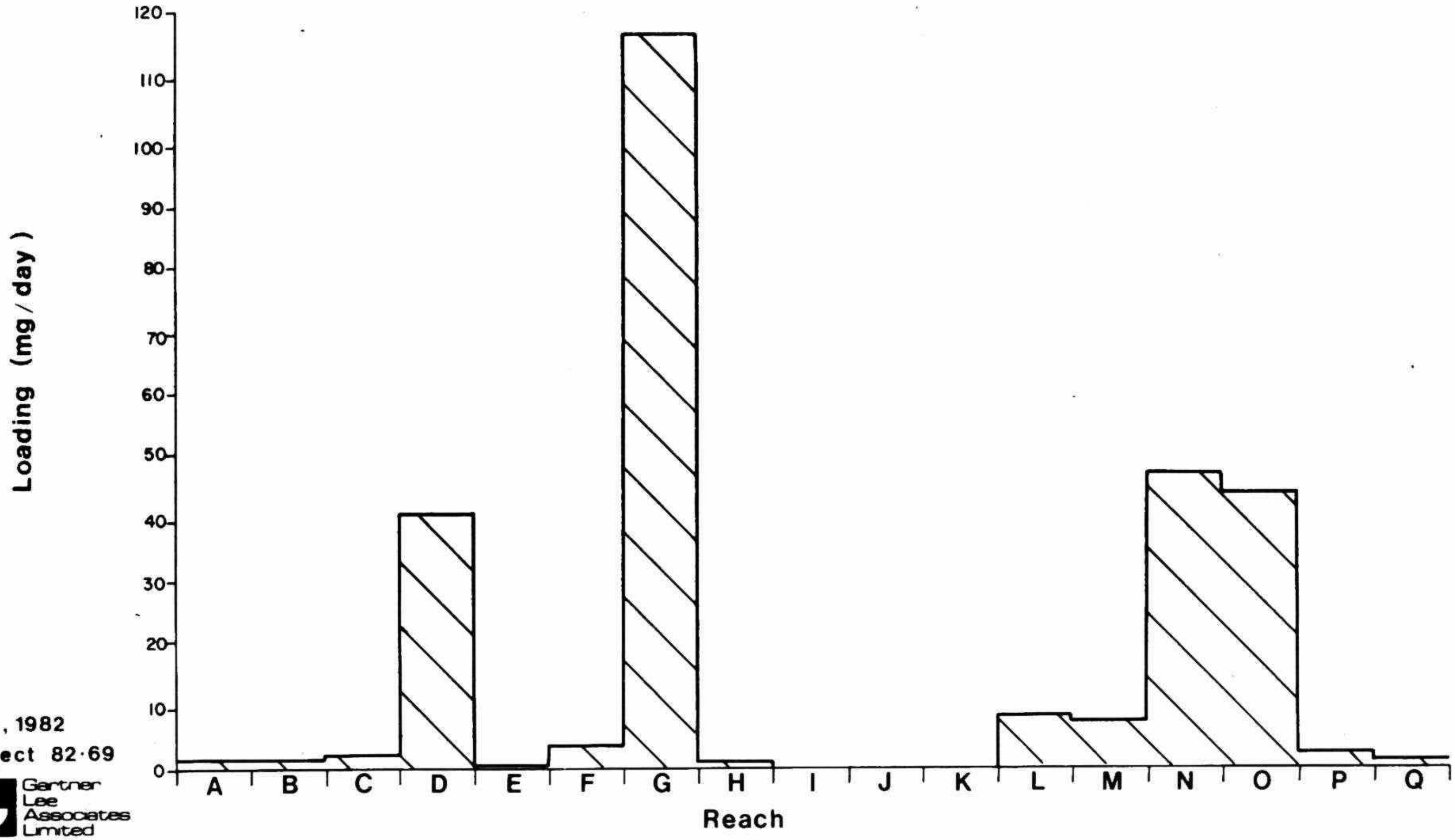

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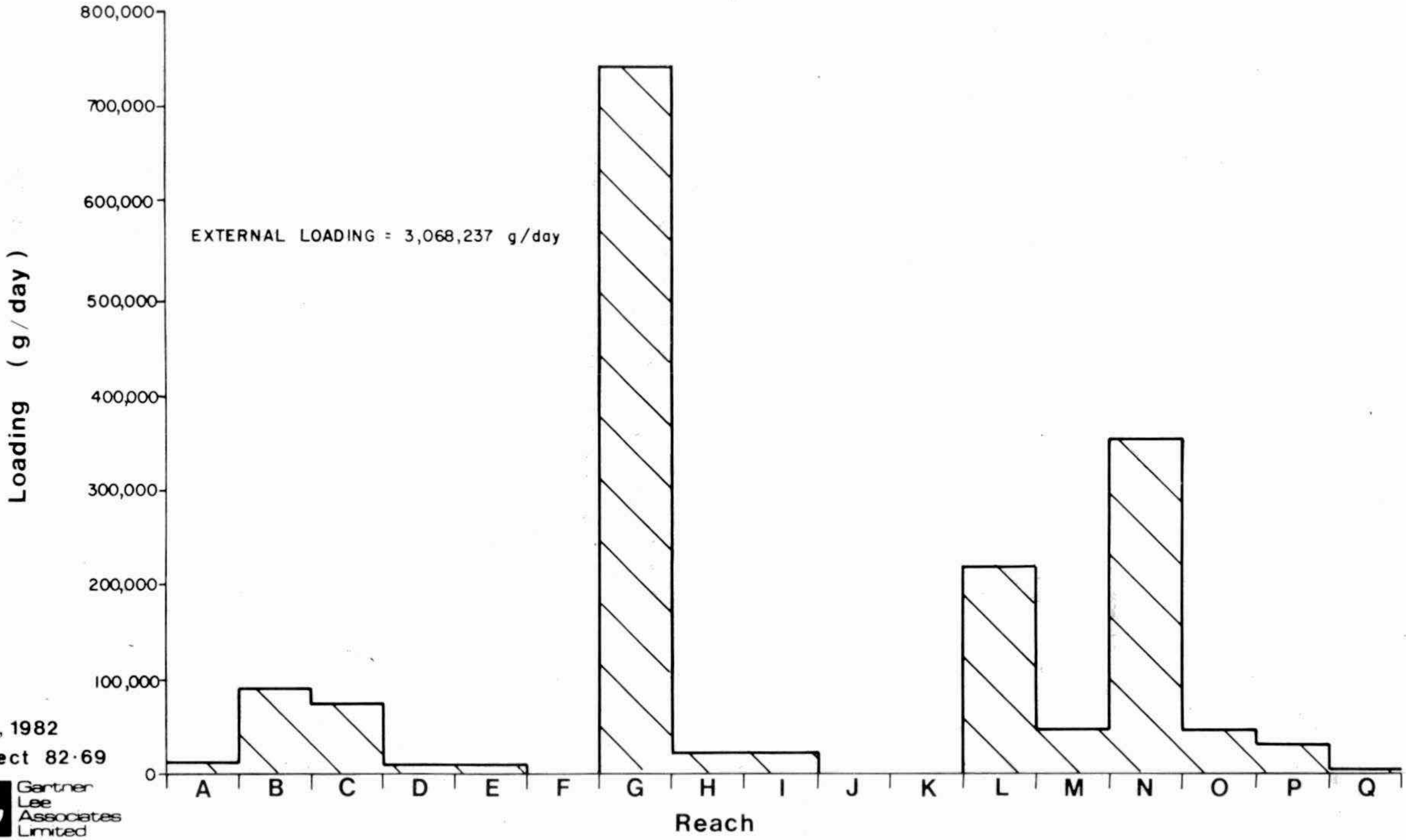
FIGURE 30

DRY WEATHER LOADING OF TOTAL SUSPENDED SOLIDS FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH



Fall, 1982
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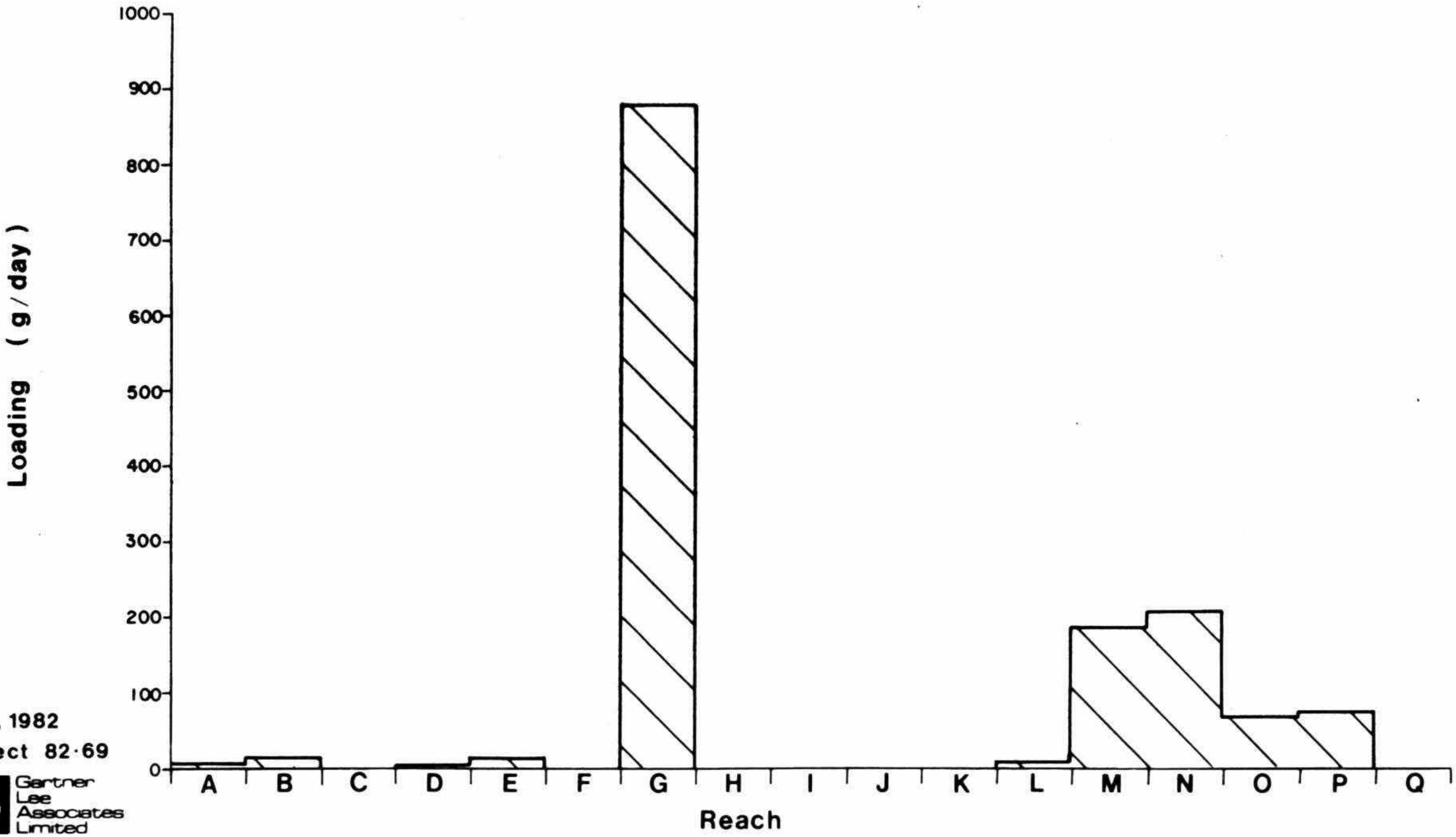
FIGURE 31

DRY WEATHER LOADING OF TOTAL LEAD FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH



Fall, 1982
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FIGURE 32
DRY WEATHER LOADING OF COPPER FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH

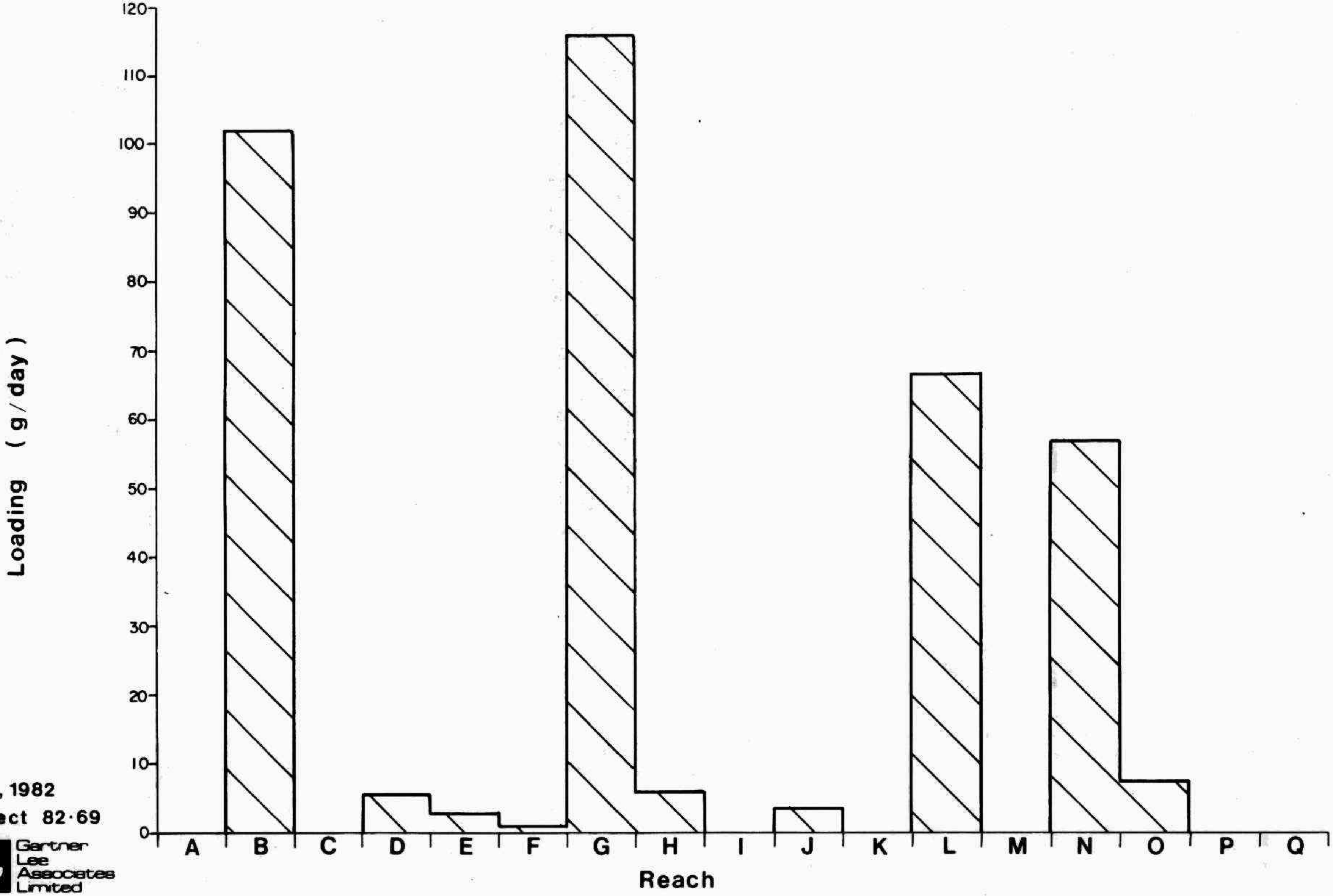

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FIGURE 33

DRY WEATHER LOADING CHROMIUM FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH

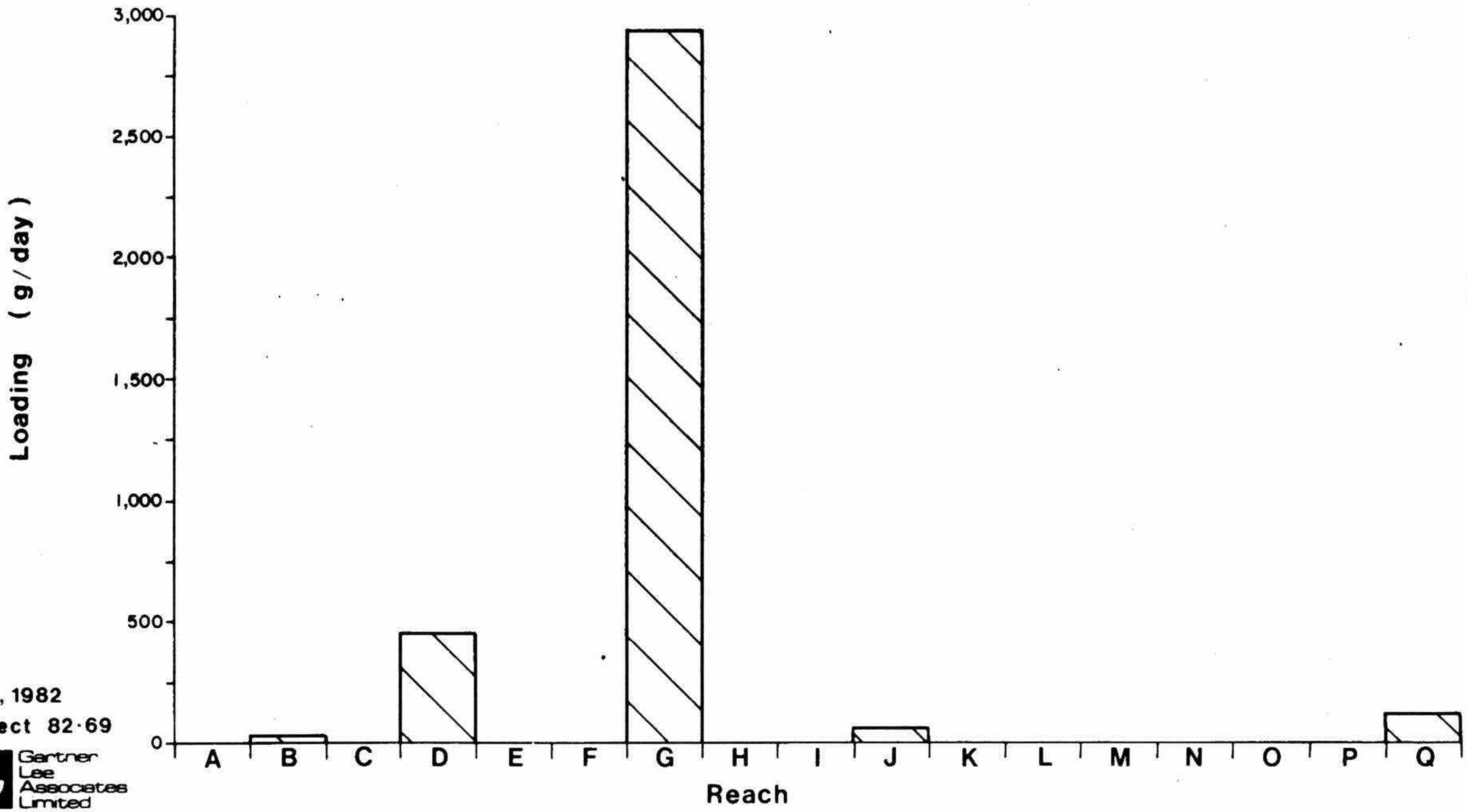

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FIGURE 34

DRY WEATHER LOADING OF TOTAL IRON FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH

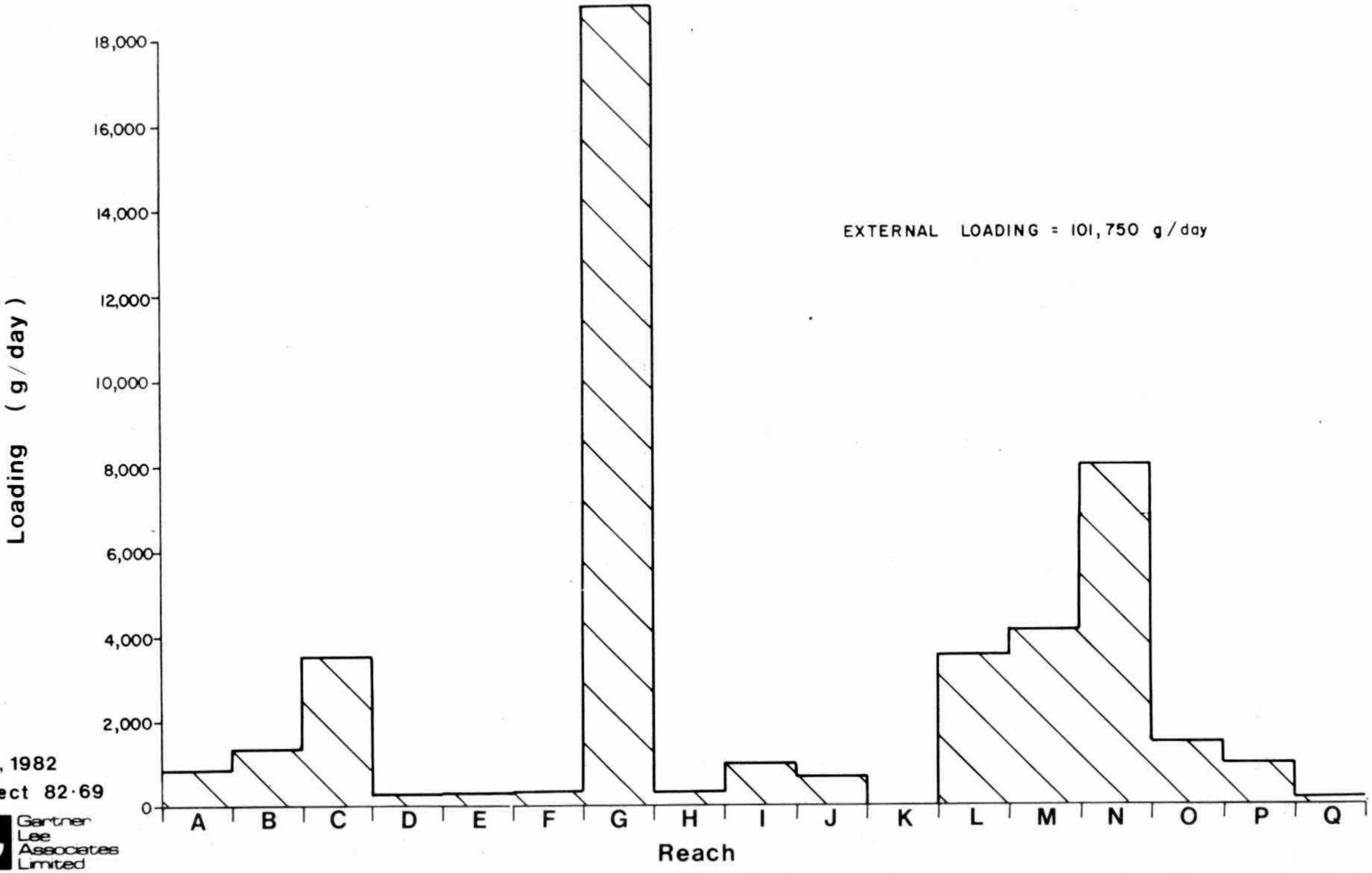

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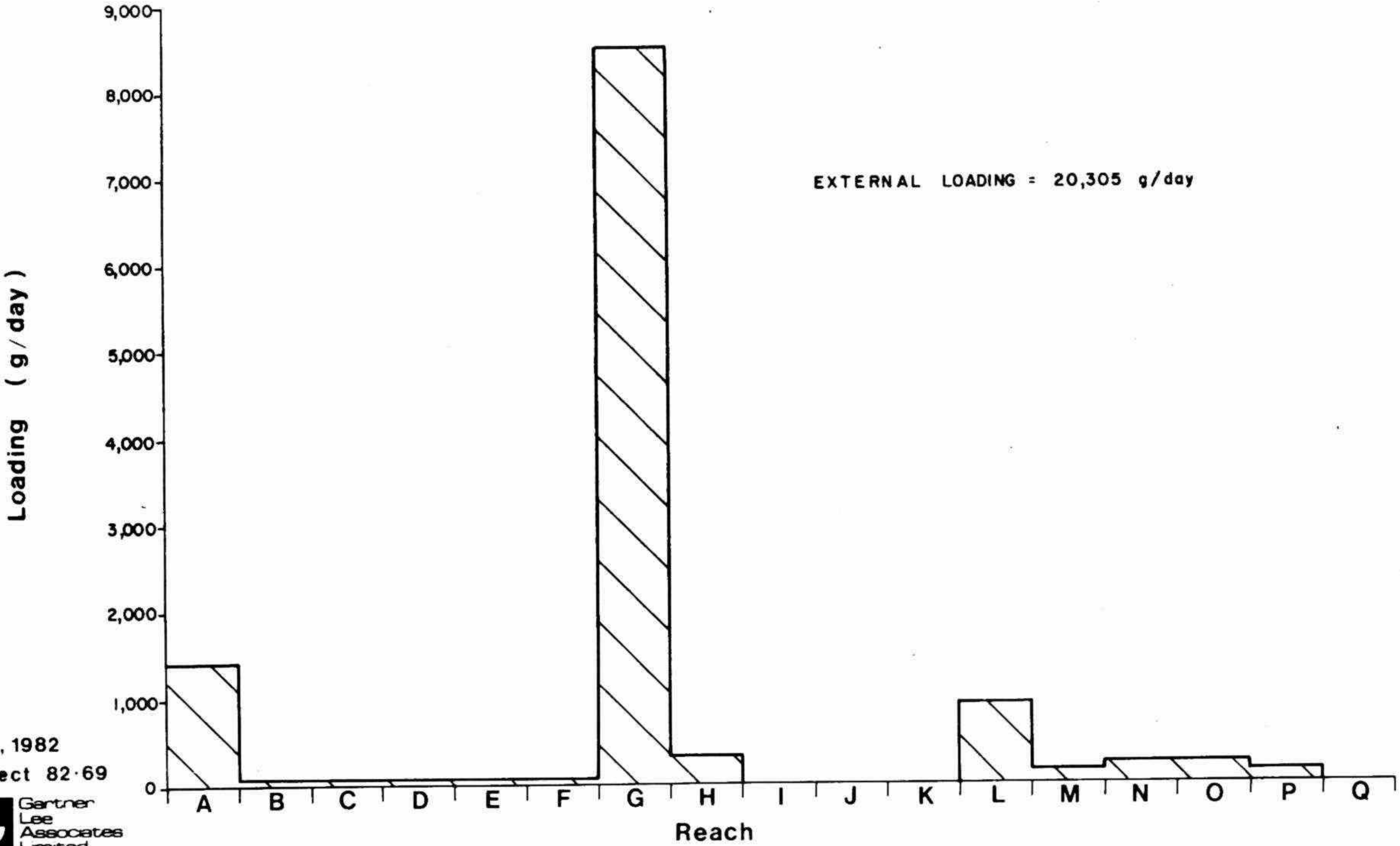
FIGURE 35

DRY WEATHER LOADING OF ZINC FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH



Fall, 1982
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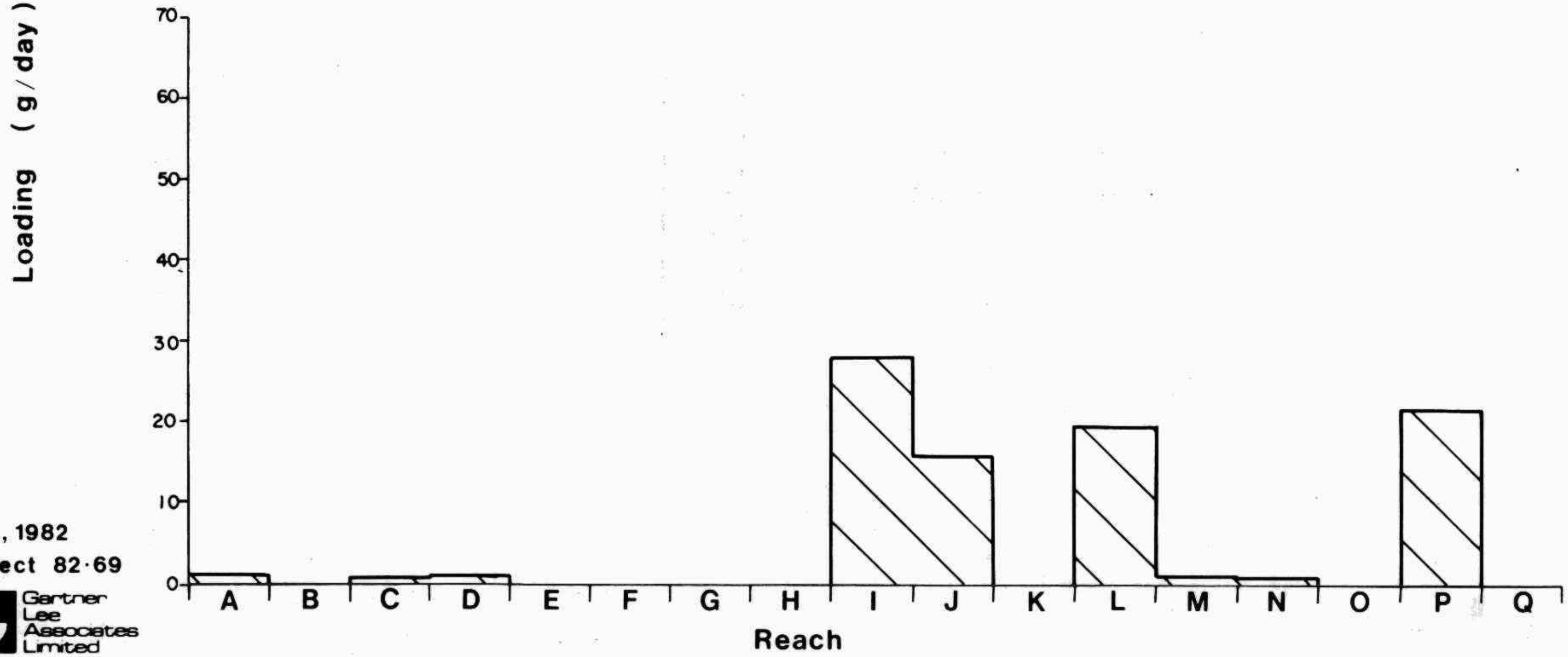
FIGURE 36

DRY WEATHER LOADING OF TOTAL MERCURY FROM OUTFALLS TO HUMBER RIVER SYSTEM BY REACH



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percent contribution of the total load for each parameter as follows:

- outfall contributes 1% - 5% of the total dry weather load
- " " 5% - 10% " " " " "
- " " >10% " " " " "

Outfalls contributing less than 1 % were assigned low priority. The results of this partitioning are provided in Table 8.

A total of 60 outfalls were assigned priority based on the fact that they contribute more than 1% of the total dry weather load for at least one chemical parameter. Thirteen of these contribute more than 10% of the total load for at least one parameter. A discussion of the priority outfalls under selected parameter groups follows:

(i) *Nutrients/TKN, NH_3, P*

There are 29 outfalls with significant loadings of the nutrients-Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_3) and Total Phosphorus (P). As shown on Table 8 Outfalls 139 and 504 are the most significant. Outfall 139 alone contributes 8.6 and 28% of the total loads for TKN, and Total P to the study area respectively. Outfall 504 contributes 16% of the Total P. Outfalls 29, 39, 123, 193, 301, 441 and 502 are of moderate significance, each contributing between 1% and 5% of selected nutrients.

TABLE 8: SUMMARY OF CONTAMINATED OUTFALLS

PARAMETER	AVERAGE CONTRIBUTION TO DRY WEATHER LOADING OF STUDY AREA		
	1% - 5% *	5% - 10% *	> 10% *
TKN	18, 125, 127, 129, 132, 193 209, 225, 244, 269, 270, 354, 367, 371, 383, 385, 393, 395, 499, 502, 504, 509, 537, 589	123, 139	
AMMONIA	18, 39, 83, 123, 125, 127, 129, 132, 209, 225, 244, 367, 381, 393, 395, 497, 502, 504, 589	193	139
TOTAL P	17, 106, 270, 279, 339, 367, 371	29, 39, 123, 441, 301, 502	504
BOD	125, 170, 191, 193, 270, 279 301, 341, 354, 367, 371, 383 385, 393, 504, 739, 741	18, 225, 502	123
COD	123, 127, 193, 209, 225, 270, 279, 301, 341, 354, 367, 371, 393, 537	18, 504, 739 741	502
PHENOLICS	123, 170, 193, 354, 739, 741		80, 279, 502 504
SUSPENDED SOLIDS	18, 127, 193, 247, 471, 509, 537, 741	393	739, 502, 504
LEAD	247, 264, 279, 309, 399, 741	393, 739	209, 502, 504
COPPER	18, 33, 109, 140, 289, 483	509, 739, 741	97, 502

TABLE 8: SUMMARY OF CONTAMINATED OUTFALLS

PARAMETER	AVERAGE CONTRIBUTION TO DRY WEATHER LOADING OF STUDY AREA		
	1% - 5% *	5% - 10% *	> 10% *
CHROMIUM	140, 431, 504		39, 502
IRON	2, 83, 127, 139, 140, 191, 193, 194, 209, 213, 244, 270, 509, 537, 739, 741	247, 504	502
ZINC	507	97, 504	502
MERCURY	29, 123, 213, 292		97, 140, 393

* As a proportion of the total load for each parameter from sampled outfalls within the study area.

(ii) Oxygen Related Parameters (BOD, COD)

There are 24 outfalls which individually contribute more than 1% of total BOD or COD load. Only two outfalls (123 and 502) each produce greater than 10% of the total load. Outfall 123 contributes 11% of the BOD with Outfall 502 contributing 17% of the COD and 6% of the BOD load. Outfalls 18, 225 504, 739 and 741 each contribute between 1% and 5% of the BOD or COD load.

(iii) Phenolics

Loading calculations for phenolics are in mg/day. Samples for phenolic analyses were taken only at outfalls that had a noticeable odour. There are 8 outfalls with significant phenolic loads. Four (Outfalls 80, 279, 502 and 504) each contribute greater than 8% of the total load and collectively account for 68% of the total phenolic load.

The outfall with the highest individual load is Outfall 504 at 79 mg/day or 28% of the total phenolic load to the study area.

(iv) Suspended Solids

Twelve outfalls are regarded as priority outfalls in terms of their contribution to the suspended solids load. Three of these (Outfalls 502, 504, and 739) individually produce greater than 10% of the total suspended solids load and together are responsible for about 58% of the total dry weather load.

(v) Metals: (Lead, Copper, Chromium, Iron, Zinc, Mercury)

There are 37 outfalls considered to contribute significant loads of selected metals to the study area. Of these, 7 are most significant contributing more than 10% of any particular metal.

Outfalls 209, 502 and 504 account for 77% of the observed lead load. Outfalls 502 and 97 contribute 44% of the copper. Outfall 502 contributes 79% of the observed chromium with Outfall 39 adding an additional 11% of the total chromium load. Outfall 502 also contributes 29% of the observed iron and 64% of the zinc loads. It is by far the most significant outfall with respect to metal loadings. Outfalls 97, 140 and 393 together account for 92% of the observed Mercury load, although mercury was tested only during the Intensive Phase.

4.2 BACTERIAL LEVELS:

Priority outfalls from a bacteriological point of view were identified by comparing population densities expressed as geometric mean values per 100 ml of sample. Individual results are provided in Appendix B.

We have chosen to identify the priority outfalls, in terms of bacteria, by partitioning off the highest geometric mean results. Any mean counts of greater than 10^4 were regarded as indicative of a priority

outfall. Table 9 contains a list of those outfalls with geometric mean levels of fecal coliforms and fecal streptococci between 10^4-10^5, 10^5-10^6 and greater than 10^6/100 ml of sample.

Table 9 contains a total of 29 outfalls which are considered significant sources of bacteria. This table shows 18 outfalls with fecal coliform counts between 10^4 and 10^5/100 ml, 6 outfalls with fecal coliform counts between 10^5 and 10^6, and Outfall 125 with a geometric mean fecal coliform count of over 1.2×10^6/100 ml. Similarly, there are 13 outfalls with fecal streptococci exceeding 10^4/100 ml and Outfalls 123 and 125 with levels of fecal streptococci of 810,000/100 ml and 465,000/100 ml, respectively. It should be noted that 9 outfalls are significant for both types of bacteria.

In all cases, outfalls identified as having priority were flowing during dry weather conditions and most of the 29 produced flows of greater than 0.1 L/s. It is recognized that our "population approach" includes some outfalls with extremely low flows and very high bacterial populations and ignores some outfalls with higher flows and populations lower than our cut-off level of 10^4. To overcome this, MOE staff applied a "loading approach" which expressed bacteria in terms of organisms per second. This approach utilized internally, has resulted in an expansion of the priority outfall list in terms of bacteria to 54 outfalls.

Both approaches have their strengths and weaknesses.

TABLE 9: PRIORITY OUTFALLS IN TERMS OF BACTERIOLOGICAL CONTAMINATION DURING DRY WEATHER CONDITIONS

Bacteria	Reach	OUTFALL NUMBERS		
		Bacteria Count* 10^4-10^5	10^5 - 10^6	>10^6
Fecal Coliforms	A	300		
	B	4 18		
	C	28 32		
	D	37		
	E	106		
	G	252 378		
	L	87 135	69 75 85 123	125
	M	179	181	
	N	237	269	
	O	371		
	P	393 395		
	Q	417 433		
Fecal Strepto-cocci	B	4 18		
	G	378 504		
	L	69	123 125	
	M	181		
	N	269		
	O	279 699		
	P	387		
	Q	417		

* Geometric Mean Count /100 ml

The population approach ensures that those outfalls which pose the greatest threat to health are identified regardless of flow; however, those which are of a less immediate threat to health but contribute a greater load may be overlooked. The loading approach may eliminate the high population-low flow outfall but catch those contributing a greater overall load.

Regardless which approach is applied, the difficulty of predicting ultimate distribution and abundance of bacteria from specific sources in the surface water receiver should be appreciated. Die-off and proliferation rates are highly dependent upon ambient physical and chemical conditions in the receiving water body. Unsatisfactory growth conditions in the receiving stream could result in an immediate reduction in bacterial numbers and only a localized effect. Optimal conditions either near the source or further downstream could result in an increase or "regrowth" of bacterial populations above the numbers at the source.

4.3 OUTFALL HIGHLIGHTS BY REACH:

This section briefly highlights the significant outfalls on a Reach-by-Reach basis.

Reach A: Outfall 300 has a mean fecal coliform count of 15560/100 ml. Outfall 507 contributes a significant zinc loading, 497 - NH_3, 499 - TKN and 292 contributes significant mercury.

Reach B: Outfalls 4 and 18 have significant fecal bacteria populations, Outfalls 14, 18 and 509 produce significant loads of BOD, COD and copper, and iron, respectively. Outfall 18 also contributes additional loadings of all parameter groups and is the most significant outfall on the Humber River below Highway 401.

Reach C: Outfalls 28 and 32 contribute significant fecal bacterial densities, Outfall 2 - significant iron loads (1200 g/day), Outfall 537 - high loads of both iron and suspended solids with Outfall 17 contributing significant Total P.

Reach D: Outfall 80 contributes 36 g/day of phenolics or 13% of the total load. Outfall 39 contributes significant chromium (404 g/day) and phosphorous loads (1182 g/day). Outfall 37 has a significant bacteria count. Outfalls 29 and 33 are significant contributors of nutrients and copper. Outfall 354 is a significant contributor of TKN, BOD, COD and phenolics.

Reach E: Outfalls 106 and 132 are significant contributors of fecal coliforms and nutrients, respectively.

Reach F: The only significant Outfall in this reach is #170 contributing 7300 g/day of BOD and 3.9 mg/day of phenolics.

Reach G: This reach contains two of the three most significant contributors of all contaminants to the study area.

Outfalls 502 and 504 in Emery Creek make significant contributions of nutrients (504-16% of the total phosphorous load), BOD and COD, phenolics (40% of the total load), suspended solids (43% of the total load with contributions of individual heavy metals in the order of 1%-80% of the total load. One is referred to Appendix A, Table A3G for detailed loads. These outfalls are storm drains for industrial land uses. Outfalls 252 and 378 contribute significant fecal coliform populations with Outfalls 270 and 264 contributing significant loads of nutrients and metals.

Reach H: Outfalls 441, 471 and 483 contribute significant nutrients, suspended solids and copper loads, respectively.

Reaches I, J and K: (West Branch of Humber River). Outfalls 244, 140 and 194 located in Reaches I, J and K, respectively, contribute significant loads of nutrients and iron, metals, and iron, respectively.

Reach L: Reach L on Black Creek below Lawrence Avenue contains one of the 3 most significant outfalls in the study area -- Outfall 123 -- as well as the largest number of bacteriologically significant outfalls.

Outfall 123 contributes the following proportions of the total loads:

TKN	-	10%	or 5635.6 g/day
NH_3	-	4%	or 833.8 g/day
Total P	-	5%	or 1121.5 g/day

BOD	- 11.5%	or	40294	g/day
COD	- 5 %	or	82533	g/day
SS	- 7 %	or	118329	g/day
Hg	- 3 %	or	2.5	g/day

Fecal Coliforms - 500220/100 ml
Fecal Streptococci - 810000/100 ml

It is a storm sewer draining in the industrial land at the intersection of Keele Street and St. Clair Avenue.

Seven more outfalls (69, 75, 81, 85, 87, 125 and 135) exhibited high bacteriological counts. Outfalls 97 and 109 contribute significant metals and copper, respectively. Outfalls 83, 109, 125, 127, 129 and 139 also produce significant loads of selected parameters.

Reach M: Outfall 193 contributes significant loads of nutrients, BOD and COD, phenolics, suspended solids and iron. Outfalls 179 and 181 are significant contributors of fecal coliform bacteria. Outfalls 191, 209, 213 and 589 are also significant.

Reach N: Reach N is probably the third most significant reach, behind Reaches G and L. Outfalls 739 and 741 both contribute significant loadings of metals (lead, copper and iron), phenolics, suspended solids and COD. They would rank among the top five priority outfalls within the study area. Outfall 247 contributes 3200 g/day of iron. Outfall 225 contributes significant loads of TKN, NH_3-N, BOD and COD, with Outfall 269 contributing significant TKN.

Reach O: Outfalls 279, 289, 301, 309, 339, 341, 367 and 371 were observed to be significant contributors of a limited number of parameters at the "1%-5% of total load" range. Outfalls 371 and 699 exhibited significant counts of fecal coliforms and fecal streptococci, respectively.

Reach P: Outfall 393 is the most significant outfall in this reach contributing significant loads of TKN, NH_3-N, BOD, COD, mercury and high fecal coliform populations. Other outfalls of lesser significance are 381 (NH_3), 383 and 385 (TKN, BOD), 395 (nutrients and fecal coliforms) and 399 (lead).

Reach Q: Outfalls 417 and 433 are significant contributors of fecal bacteria. Outfall 431 contributes significant chromium loads (125 g/day).

5.0 CONCLUSIONS AND RECOMMENDATIONS:

5.1 CONCLUSIONS:

A number of conclusions can be drawn from the results of this study. The conclusions fall within four major categories which will be used for discussion purposes:

- study approach/management
- outfall mapping/characterization
- distribution of contaminant loading; and
- priority outfalls

5.1.1 STUDY APPROACH/MANAGEMENT:

- *Direct field investigations of storm sewer locations and activity have proved useful in updating outfall inventories and in locating significant dry weather contaminant sources to the Humber River in the Toronto area.*

While 435 outfalls were expected from the 1972 studies, an additional 189 were discovered for a total of 624 outfalls in the study area. The three most significant dry weather contaminant sources had not been inventoried prior to this study because sampling did not extend to the source of every tributary.

- *The use of Municipal field crews in the mapping and sampling program was very*

effective provided crew members were carefully selected, properly instructed and supervised by qualified staff.

- *The use of a computerized data base was not satisfactory for day-to-day project management of this study.*

Outfall sheets prepared manually were effective in day-to-day project management. Decisions on outfall screening, priority outfalls and up-to-date effluent quality were readily available on regularly maintained outfall tables. An interactive computer system would have to be up and running <u>prior to</u> sample collection to be effective. Such a system would shorten data analysis time and allow more timely preparation of a report.

- *Of the field parameters utilized for a quick characterization of effluent quality, conductivity was the most effective for day-to-day decision making purposes.*

Significant time was spent calibrating D.O. meters and taking pH readings that could be better spent mapping and sampling. The screening and sampling exercise requires the transport of large numbers of bottles, meters, cameras and other essential equipment into the field. The results of this study suggest that the pH and D.O. meters were unnecessary baggage.

- *Laboratory analytical capacity became one of the major controlling factors of the number of outfalls sampled and number of tests conducted.*

Owing to the unexpectedly large number of active outfalls found and sampled in the two screening runs, sampling frequency in the intensive run had to be reduced. This in part, compensated for the high proportion of the laboratory test allocation that had already been used before the intensive sampling phase began.

- *Two screening runs were required to locate the majority of outfalls that were ultimately inventoried during this study.*

In the first screening run, 432 outfalls were located. Not until completion of the second screening run when an additional 173 outfalls were inventoried did return on the field mapping effort become significantly diminished.

- *Outfall numbering with paint accompanied by a photographic catalogue of each outfall greatly facilitated follow-up relocation.*

Outfalls identified during screening runs were easily relocated if they were resampled. The system has proved effective in subsequent visits by Municipal staff for sampling or remedial purposes.

5.1.2 OUTFALL MAPPING/CHARACTERIZATION:

- *In this study, 624 outfalls were identified, mapped and described. This was over 40% more outfalls than was expected, based on earlier inventories.*

- *During dry weather flow conditions, 366 (59%) of the 624 outfalls were actively flowing.*

- *Two hundred and thirty-nine (239) of the active outfalls produced sufficient discharge to be sampled. Of these, 137 discharged at a rate in excess of 1 L/s. However, 127 active outfalls were not able to be sampled.*

This reveals that approximately 38% of the outfalls mapped were sampled. This proportion compares favourably with a prediction of 34% based on earlier studies.

- *Of the 624 outfalls mapped, 84 (13%) were considered sufficiently contaminated during dry weather conditions, to warrant intensive water quality sampling and testing.*

It should be appreciated that selection of the more 'contaminated' outfalls for intensive sampling relates directly to selection guidelines applied and laboratory testing capacity available. It is acknowledged that lesser contaminated outfalls which did not fall within selection criteria for intensive sampling were therefore only sampled once. These outfalls may indeed contribute to the contamination of the Humber River in the Toronto area.

5.1.3 DISTRIBUTION OF CONTAMINANT LOADING:

- *The average daily dry weather load from the urban watershed of the study area was similar*

to that flowing into the study area from upstream for phosphorus, COD, BOD and suspended solids.

Loadings ranged from approximately 25 kg per day of phosphorus from both external and dry weather outfall sources to approximately 1,700 kg per day for COD and suspended solids.

- *Study area sewers contribute significantly more nitrogen, phenolics and metals during dry weather conditions than what enters Metro in Humber River water from upstream.*

Approximately 60% more total nitrogen (60 kg) originates from dry weather sewer sources as from upstream waters (38 kg) on a daily basis. Many metal species were not found in detectible concentrations in the Humber River but were present in measurable quantities in study area dry weather sewer discharges.

- *Certain study area Reaches appear to contribute the bulk of specific categories of chemical loadings to the study area.*

Reach L is the major contributor of nutrients and oxygen-demanding contaminants. As well, it contributes significantly to the overall burden of certain metals. Reach G is the major source of several metals species and contributes significantly to all other categories of

contaminants. Other reaches producing significant contaminant burdens are Reach N (suspended solids/ phenolics; metals; oxygen demanding contaminants); Reach O (nutrients, suspended solids/phenolics) and Reaches B, D and P.

- *This study revealed that the most significant contributions of chemical contaminants during dry weather conditions originate from industrial catchments or areas of industrial land use.*

5.1.4 PRIORITY OUTFALLS:

- *A total of 60 outfalls each contributed more than 1% of the total dry weather contaminant load for at least one chemical parameter. This compares with 30 outfalls which produced fecal bacterial population densities of more than 10,000 counts per 100 ml of sample.*

In other words, 10% of the outfalls identified and mapped were judged as significant contributers of chemical contaminants; 5% produced high fecal bacterial population densities.

- *Nine (9) outfalls identified as a priority for chemical contaminants were also priorities for bacteriological contaminants. Where such overlap occurred, the outfalls were major contributors of BOD, nutrients and/or suspended solids.*

There appeared to be a correlation between rich organic discharges with high bacterial counts, as one would expect. The nine outfalls of priority for both chemical and bacteriological parameters are Outfall Numbers 18, 106, 123, 125, 269, 371, 393, 395 and 504.

- *Three (3) outfalls - Numbers, 139, 502 and 504 - are responsible for a major portion of the total dry weather contaminant load for many chemical contaminants.*

Number 502 is the source of 79% of the total chromium load, 64% of the zinc load and contributes significantly to the total suspended solids, phenols and iron burden in the study area. Outfall 504 produces 28% of the total phenolic loading and is a major contributor to the suspended solids burden. Twenty-eight percent (28%) of the total ammonia loading comes from Outfall 139.

- *Bacteriological parameters were responsible for the designation of the highest number of outfalls as significant followed by the chemical parameters TKN, ammonia and BOD. Only three outfalls were deemed significant contributors of mercury.*

Table 10 presents the number of outfalls which produce greater than 1% of the total study area load of chemical contaminants or high (>10,000 counts/100 ml) bacteriological population densities.

5.2 RECOMMENDATIONS:

Based on these conclusions, the following recommendations are made:

5.2.1 STUDY APPROACH/MANAGEMENT

1. Experience gained from this project on study approach and management should be utilized in defining the scope and assisting in the management of future studies of dry weather contaminant sources in urban watersheds.

2. An interactive computerized data-base should be up and running *prior to* sample collection. The designation of a part-time data-person to operate the system on a daily basis would assist the project management with more timely data. Interaction with the Ministry's own LIS system would reduce the delay in receiving analytical results, reduce the multiple-handling of data and speed up the decision processes of outfall screening or selection.

3. The scope of laboratory allocations should be evaluated conservatively to allow for

TABLE 10: NUMBER OF SIGNIFICANT OUTFALLS

PARAMETER	NO. OUTFALLS WITH SIGNIFICANT CONTRIBUTION
TKN	26
NH_3	21
TOTAL P	14
BOD	21
COD	19
PHENOLICS	10
S.S.	12
PB	11
CU	11
CR	5
ZN	5
HG	7
F. COLIFORM	25
F. STREPTOCOCCI	13

previously unmapped outfalls. Approximately one-third of the outfalls mapped in this study were previously unmapped.

4. Early discussions about the levels of screening thresholds should be held as part of a review of projected analytical requirements.

5.2.2 OUTFALL MAPPING & CHARACTERIZATION:

5. Two screening runs for the mapping and sampling of outfalls up to the source of every tributary is recommended. This duplicity is to facilitate a reasonably objective first screening run and to correct errors and omissions on the second run.

6. Conductivity and temperature should be considered as primary field parameters. These parameters are reliable indicators of both contamination and the presence of storm water. Equipment is easily transported in the field and virtually failsafe.

5.2.3 DISTRIBUTION AND PRIORITY OUTFALLS:

7. While different land uses affect the relative loadings of each parameter, industrial sewersheds appear to warrant particular attention in efforts to reduce dry weather discharge load.

8. By focussing remedial measures on just four outfalls (Numbers 123, 139, 502, 504) a significant proportion of the contamination entering the Humber River Basin from active dry weather outfalls could be addressed.

9. By extending remedial measures to include Outfalls 39, 97, 140, 209, 279, 393, 739 and 741, the more significant sources of dry weather contamination would be addressed.

10. Efforts to improve the bacteriological quality of sewer effluents within the study area should initially be concentrated on outfalls to Black Creek, below Weston Road.

11. Long term remedial plans should include the characterization of inaccessible outfalls unsampled during this study and those outfalls contributing lesser contaminant loads through low concentrations of parameters at high flow rates.

12. Implementation of remedial measures and their results should be documented to record the expected benefits of identifying and priorizing dry weather outfalls in problem sewersheds.

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APPENDIX A

TABLE A1 - FIELD DATA METHODS

TABLE A1: FIELD DATA COLLECTION METHODS

PARAMETER	EQUIPMENT	COMMENT
Dissolved Oxygen	Meter - YSI Model 57	Meter calibrated in saturated water each morning and through the day
Water Temperature	- D.O. meter as above - Mercury thermometer, °C	
pH	Metronic pH meter	Measured in the field within 3 hours of collection
Flow rate	- water velocity meters	- rarely used because of insufficient depth of flow
	- calibrated bucket and stopwatch	- rarely used - few free overfalls
	- visual estimate in terms of trickle, slight or no flow	- dominant method because discharges were small and usually difficult to collect
	- visual in terms of L/s	- occasionally done by project hydrologist based on experience

Table A2 - Numerical List of Outfall Locations

TABLE A2

NUMERICAL LISTING OF OUTFALL LOCATIONS

OUTFALL	CITY	REACH	OUTFALL	CITY	REACH	OUTFALL	CITY	REACH
1	ET	B	33	YK	D	65	ET	C
2	ET	C	34	YK	C	66	ET	D
3	ET	B	35	YK	D	67	YK	L
4	YK	B	36	ET	D	68	ET	D
5	ET	B	37	YK	D	69	YK	L
6	YK	B	38	ET	D	70	ET	D
7	ET	B	39	YK	D	71	YK	L
8	YK	B	40	ET	D	72	ET	D
9	ET	B	41	YK	D	73	YK	L
10	YK	B	42	ET	D	74	ET	D
11	ET	B	43	YK	D	75	YK	L
12	YK	B	44	ET	D	76	ET	D
13	ET	B	45	ET	D	77	YK	L
14	YK	B	46	YK	D	78	ET	D
15	ET	C	47	YK	D	79	YK	L
16	YK	B	48	ET	D	80	ET	D
17	ET	C	49	YK	D	81	YK	L
18	YK	B	50	ET	D	82	ET	D
19	ET	C	51	YK	D	83	YK	L
20	YK	B	52	ET	D	84	ET	D
21	ET	C	53	YK	D	85	YK	L
22	YK	C	54	ET	D	86	ET	D
23	ET	C	55	ET	C	87	YK	L
24	YK	C	56	ET	D	88	ET	D
25	ET	C	57	ET	C	89	YK	L
26	YK	C	58	ET	D	90	ET	D
27	ET	C	59	ET	C	91	YK	L
28	YK	C	60	ET	D	92	ET	D
29	YK	D	61	ET	C	93	YK	L
30	YK	C	62	ET	D	94	ET	D
31	YK	C	63	ET	C	95	YK	L
32	YK	D	64	ET	D	96	ET	D

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OUTFALL	CITY	REACH	OUTFALL	CITY	REACH	OUTFALL	CITY	REACH
97	YK	L	133	YK	L	169	YK	L
98	ET	D	134	ET	J	170	NY	F
99	YK	L	135	YK	L	171	YK	M
100	ET	D	136	ET	J	172	NY	F
101	YK	L	137	YK	L	173	YK	M
102	ET	D	138	ET	J	174	NY	F
103	YK	L	139	YK	L	175	YK	M
104	ET	E	140	ET	J	176	ET	F
105	YK	L	141	YK	L	177	YK	M
106	ET	E	142	ET	J	178	ET	F
107	YK	L	143	YK	L	179	YK	M
108	ET	E	144	ET	J	180	ET	F
109	YK	L	145	YK	L	181	YK	M
110	ET	E	146	ET	J	182	ET	F
111	YK	L	147	YK	L	183	NY	M
112	ET	E	148	ET	J	184	ET	F
113	YK	L	149	YK	L	185	NY	M
114	ET	E	150	ET	E	186	ET	K
115	YK	L	151	YK	L	187	NY	M
116	ET	E	152	YK	E	188	ET	K
117	YK	L	153	YK	L	189	NY	M
118	ET	E	154	YK	E	190	ET	K
119	YK	L	155	YK	L	191	NY	M
120	ET	E	156	NY	E	192	ET	K
121	YK	L	157	YK	L	193	NY	M
122	ET	E	158	NY	E	194	ET	K
123	YK	L	159	YK	L	195	NY	M
124	ET	E	160	NY	E	196	ET	K
125	YK	L	161	YK	L	197	NY	M
126	YK	E	162	NY	F	198	ET	F
127	YK	L	163	YK	L	199	NY	M
128	YK	E	164	NY	F	200	ET	F
129	YK	L	165	YK	L	201	NY	M
130	YK	E	166	NY	F	202	ET	F
131	YK	L	167	YK	L	203	NY	M
132	YK	E	168	NY	F	204	ET	F

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OUTFALL	CITY	REACH	OUTFALL	CITY	REACH	OUTFALL	CITY	REACH
205	NY	M	241	NY	N	277	NY	N
206	ET	F	242	ET	I	278	ET	A
207	NY	M	243	NY	N	279	NY	O
208	ET	I	244	ET	I	280	ET	A
209	NY	M	245	NY	N	281	NY	O
210	ET	I	246	NY	G	282	ET	A
211	NY	M	247	NY	N	283	NY	O
212	ET	I	248	NY	G	284	ET	A
213	NY	M	249	NY	N	285	NY	O
214	ET	I	250	ET	G	286	ET	A
215	NY	M	251	NY	N	287	NY	O
216	ET	I	252	ET	G	288	ET	A
217	NY	M	253	NY	N	289	NY	O
218	ET	I	254	NY	G	290	ET	A
219	NY	M	255	NY	N	291	NY	O
220	ET	I	256	NY	G	292	ET	A
221	NY	N	257	NY	N	293	NY	O
222	ET	I	258	NY	G	294	ET	A
223	NY	N	259	NY	N	295	NY	O
224	ET	I	260	ET	G	296	ET	A
225	NY	N	261	NY	N	297	NY	O
226	ET	I	262	ET	G	298	ET	A
227	NY	N	263	NY	N	299	NY	O
228	ET	I	264	NY	G	300	ET	A
229	NY	N	265	NY	N	301	NY	O
230	ET	I	266	NY	G	302	ET	A
231	NY	N	267	NY	N	303	NY	O
232	ET	I	268	NY	G	304	ET	B
233	NY	N	269	NY	N	305	NY	O
234	ET	I	270	NY	G	306	ET	F
235	NY	N	271	NY	N	307	NY	O
236	ET	I	272	ET	A	308	ET	F
237	NY	N	273	NY	N	309	NY	O
238	ET	I	274	ET	A	310	ET	F
239	NY	N	275	NY	N	311	NY	O
240	ET	I	276	ET	A	312	ET	F

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OUTFALL	CITY	REACH	OUTFALL	CITY	REACH	OUTFALL	CITY	REACH
313	NY	0	349	NY	0	385	NY	P
314	ET	F	350	ET	D	386	NY	G
315	NY	0	351	NY	0	387	NY	P
316	ET	F	352	ET	D	388	ET	I
317	NY	0	353	NY	0	389	NY	P
318	ET	F	354	ET	D	390	ET	I
319	NY	0	355	NY	0	391	NY	P
320	ET	F	356	ET	D	392	ET	I
321	NY	0	357	NY	0	393	NY	P
322	ET	D	358	YK	E	394	ET	I
323	NY	0	359	NY	0	395	NY	P
324	ET	D	360	ET	E	396	ET	I
325	NY	0	361	NY	0	397	NY	P
326	ET	D	362	ET	E	398	ET	J
327	NY	0	363	NY	0	399	NY	P
328	ET	D	364	ET	E	400	ET	J
329	NY	0	365	NY	0	401	NY	P
330	ET	D	366	ET	E	402	ET	J
331	NY	0	367	NY	0	403	NY	Q
332	ET	D	368	ET	E	404	ET	J
333	NY	0	369	NY	0	405	NY	P
334	ET	D	370	ET	E	406	ET	J
335	NY	0	371	NY	0	407	NY	Q
336	ET	D	372	ET	E	408	ET	J
337	NY	0	373	NY	0	409	NY	Q
338	ET	D	374	ET	G	410	ET	K
339	NY	0	375	NY	0	411	NY	Q
340	ET	D	376	ET	G	412	ET	K
341	NY	0	377	NY	P	413	NY	Q
342	ET	D	378	ET	G	414	ET	K
343	NY	0	379	NY	P	415	NY	Q
344	ET	D	380	ET	G	416	ET	K
345	NY	0	381	NY	P	417	NY	Q
346	ET	D	382	ET	G	418	ET	K
347	NY	0	383	NY	P	419	NY	Q
348	ET	D	384	NY	G	420	ET	K

TABLE A2 Page 5

OUTFALL	CITY	REACH	OUTFALL	CITY	REACH	OUTFALL	CITY	REACH
421	NY	Q	457	ET	H	493	TO	A
422	ET	K	458	ET	I	494	ET	I
423	NY	Q	459	ET	H	495	TO	A
424	ET	K	460	ET	I	496	ET	I
425	NY	Q	461	ET	H	497	TO	A
426	ET	A	462	ET	I	498	ET	I
427	NY	Q	463	ET	H	499	TO	A
428	ET	A	464	ET	E	500	NY	G
429	NY	Q	465	ET	H	501	TO	A
430	ET	A	466	ET	E	502	NY	G
431	NY	Q	467	NY	H	503	TO	A
432	ET	A	468	ET	I	504	NY	G
433	NY	Q	469	NY	H	505	TO	A
434	ET	B	470	ET	I	507	TO	A
435	ET	C	471	ET	H	509	TO	B
436	ET	A	472	ET	I	511	ET	B
437	NY	H	473	ET	H	513	ET	B
438	ET	F	474	ET	I	515	ET	B
439	NY	H	475	NY	H	517	ET	B
440	ET	F	476	ET	I	519	ET	B
441	NY	H	477	NY	H	521	YK	C
442	ET	D	478	ET	I	523	ET	C
443	NY	H	479	NY	H	525	ET	C
444	ET	D	480	ET	I	527	ET	C
445	NY	H	481	ET	H	529	ET	C
446	ET	D	482	ET	I	531	ET	C
447	NY	H	483	ET	H	533	ET	C
448	ET	D	484	ET	I	535	YK	C
449	NY	H	485	ET	H	537	YK	C
450	ET	D	486	ET	I	539	YK	C
451	ET	H	487	TO	A	541	YK	L
452	ET	D	488	ET	I	543	YK	L
453	ET	H	489	TO	A	545	YK	L
454	ET	I	490	ET	I	547	YK	L
455	ET	H	491	TO	A	549	YK	L
456	ET	I	492	ET	I	551	YK	L

TABLE A2, Page 6

OUTFALL	CITY	REACH	OUTFALL	CITY	REACH	OUTFALL	CITY	REACH
553	YK	L	625	NY	0	697	NY	0
555	YK	L	627	NY	0	699	NY	0
557	YK	L	629	NY	0	701	NY	0
559	YK	L	631	NY	0	703	NY	0
561	YK	L	633	NY	0	705	NY	0
563	YK	L	635	NY	0	707	NY	0
565	YK	L	637	NY	0	709	NY	0
567	YK	L	639	NY	0	711	NY	0
569	YK	L	641	NY	0	713	NY	0
571	YK	L	643	NY	0	715	NY	0
573	YK	L	645	NY	0	717	NY	N
575	YK	L	647	NY	0	719	NY	N
577	YK	L	649	NY	0	721	NY	N
579	YK	L	651	NY	0	723	NY	N
581	YK	L	653	NY	0	725	NY	N
583	YK	L	655	NY	0	727	NY	N
585	YK	M	657	NY	0	729	NY	N
587	YK	M	659	NY	0	731	NY	N
589	YK	M	661	NY	0	733	NY	N
591	YK	M	663	NY	0	735	NY	N
593	NY	M	665	NY	P	737	NY	N
595	NY	M	667	NY	P	739	NY	N
597	NY	M	669	NY	P	741	NY	N
599	NY	N	671	NY	P	1452	ET	I
601	NY	N	673	NY	P			
603	NY	N	675	NY	P			
605	NY	N	677	ET	H			
607	YK	L	679	NY	H			
609	NY	N	681	NY	H			
611	NY	N	683	TO	A			
613	NY	N	685	ET	C			
615	NY	0	687	ET	C			
617	NY	0	689	ET	C			
619	NY	0	691	ET	C			
621	NY	0	693	ET	C			
623	NY	0	695	ET	C			

TABLE A3 A-Q - OUTFALL LOADING SHEETS

REACH A

TABLE A3A
Page 1 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	272	280	284	286	288	290	292
TKN	0.6	30.2	27.2	5.7	56.7	69.1	47.5
NH_3-N	1.6	4.3	15.6	3.6	29.7	17.3	35.6
NO_2-N							
NO_3-N							
Phosphorus - Total	0.6	3.9	2.6	0.2	5.4	3.5	17.1
Phosphorus - Soluble	0.6	2.6	1.8	0.1	1.6	3.5	3.3
BOD	31.1	173	74	19	80	259	107
COD	171	562	235	67	675	1037	368
Fecal Coliforms	80	10	315	3478	545	10	10
Fecal Strepto-cocci (count/100 ml)	40	140	329	8000	55	20	10
Phenolics (mg/day)			0.02		0.08	0.26	
Suspended Solids VSS (%)	31.1	216	416.6	26	243	259	2091 31
Lead	1.24	3.46	1.61	0.33	3.42	11.54	1.9
Copper	0.31	0.86	0.39	0.1	0.86	2.89	0.48
Chromium	0.93	2.6	1.21	0.29	2.57	8.66	1.4
Iron	1.71	18.1	30.03	1.36	30.8	5.77	167
Zinc	4.23	0.86	1.68	0.52	3.85	2.89	0.48
Mercury							0.83

REACH A

TABLE A3A
Page 2 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	294	296	298	300	489	493	497
TKN	34.6	5.2	121.8	7.8	6.0	62.2	297
NH_3-N	13.0	0.9	24.2	0.86	0.9	10.4	233.7
NO_2-N							44.2
NO_3-N							442.4
Phosphorus - Total	5.4	1.7	9.5	0.6	1.2	4.67	5.24
Phosphorus - Soluble	1.7	2.6	9.5	0.3	0.17	2.07	2.86
BOD	152	129	405	25.9	138	270	1115
COD	518	646	1620	172.8	432	1161	2226
Fecal Coliforms	1185	852	162	15649	80	266	338
Fecal Strepto-cocci (count/100 ml)	346	376	328	7304	90	262	1871
Phenolics							
Suspended Solids VSS (%)	324	323	2052	186	302	104	516
Lead	5.2	4	6.6	0.69	0.69	8.3	6.4
Copper	0.86	0.99	1.6	0.17	0.17	2.1	1.6
Chromium	2.6	3	4.92	0.52	0.52	6.2	4.8
Iron	75.6	64.6	75.5	9.55	5.6	33.2	23.4
Zinc	1.3	1.24	4.1	0.3	0.26	8.3	6.8
Mercury							

REACH A

TABLE A3A
Page 3 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	499	503	507		Total A	Total B	
TKN	605	25.9	518		1920.5		
NH_3-N	151.2	4.32	86.4		506.9	127.0	
NO_2-N					44.2		
NO_3-N					442.4		
Phosphorus - Total	151.2	5.4	26.9		245.11		
Phosphorus - Soluble	95	2.59	17.3		121.9	25.74	
BOD	1296	64.8	1728		6066.8		
COD	6264	432.0	6912		23499		
Fecal Coliforms	473	1099	610				
Fecal Strepto-cocci (count/100 ml)	455	872	750				
Phenolics (mg/day)	0.69	0.03			1.08		
Suspended Solids VSS (%)	1512	238	3456		12296 31		
Lead	34.6	3.5	69.1		5.2	157.83	
Copper	8.6	0.9	17.3			40.18	
Chromium	25.9	2.6	51.8			120.88	
Iron	170.6	29.2	138.2		924.9	5.77	
Zinc	62.6	2.8	760		1420.1	5.47	
Mercury					0.83		

REACH B

TABLE A3B
Page 1 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	1	3	4	6	7	10	11
TKN	4.8	151	66.5	138.2	96.2	36.7	7.6
NH_3-N	1.2	43.2	30.9	15.1	2.3	15.1	0.5
NO_2-N					0.6		
NO_3-N					180.6		
Phosphorus - Total	0.2	1.5	11.2	98.1	2.6	7.1	0.8
Phosphorus - Soluble	0.2	13	9.5	29.4	1.5	5.6	0.2
BOD	39.74	1512	309	778	113.2	151.2	92
COD	87.3	2376	570	4190	328	259	227
Fecal Coliforms	2746	190	27111	8916	2300	8385	234
Fecal Strepto-cocci (count/100 ml)	4487	250	10173	73	7500	1549	569
Phenolics (mg/day)		0.26	0.02	0.03		0.01	0.12
Suspended Solids VSS (%)	821	1728	214	864	985	64.8	127
Lead	0.7	34.6	3.8	6.9	1.8	3.5	0.5
Copper	0.2	8.6	1.0	1.7	0.5	0.9	0.1
Chromium	0.5	259	2.9	5.2	1.4	2.6	0.4
Iron	0.6	142.6	9.7	12.1	13.7	8	0.2
Zinc	1.51	8.6	1.7	13	0.7	1.9	0.2
Mercury							

REACH B

TABLE A3B
Page 2 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	12	14	18	20	434	509	519
TKN	173	6.8	683.4	12.41	5.2	702	0.9
NH_3-N	25.9	1.1	442.4	6.64	1.3	54	0.1
NO_2-N			5.2	0.11			
NO_3-N			919.3	19.8			
Phosphorus - Total	6.9	3.8	75.2	1.0	0.5	97.2	1.2
Phosphorus - Soluble	10.4	0.3	45.5	0.4	0.3	10.8	0.5
BOD	864	52.9	20416	32.5	13	4860	3.5
COD	1728	151.2	175271	63.3	181.4	13500	19.9
Fecal Coliforms	2291	39	38391	2940	190	2467	170
Fecal Strepto-cocci (count/100 ml)	569	69	14625	2077	10	2049	150
Phenolics (mg/day)			1.28				
Suspended Solids	346	106	39493	11.9	64.8	38340	9.5
VSS (%)				70.5			
Lead	27.6	1.2	13.3	0.5	1.0	43.2	0.07
Copper	6.9	0.3	5.4	0.1	0.3	97.2	0.02
Chromium	20.7	16.3	7.3	0.4	0.8	32.4	0.05
Iron	13.8	2.4	62.3	1.3	67.4	1026	0.28
Zinc	6.9	0.5	24.2	0.2	1.5	7.0	0.02
Mercury					0.5		

REACH B

TABLE A3B
Page 3 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	Total A	*Total B*					
TKN	2084.71						
NH_3-N	537.64	*102.1*					
NO_2-N	5.8	*0.11*					
NO_3-N	119.70						
Phosphorus - Total	299.70	*7.6*					
Phosphorus - Soluble	126.80	*0.8*					
BOD	29237.0						
COD	198952.1						
Fecal Coliforms							
Fecal Streptococci (count/100 ml)							
Phenolics (mg/day)	1.71	*0.01*					
Suspended Solids	89192	*346*					
VSS (%)	70.5						
Lead	13.3	*125.37*					
Copper	102.6	*20.62*					
Chromium	16.3	*333.65*					
Iron	1346.38	*14.0*					
Zinc	52.41	*15.52*					
Mercury		*0.5*					

REACH C

TABLE A3C
Page 1 of 4

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	2	17	21	22	23	25	27
TKN	388.0	477.8	12.2	5.7	71.3	4.3	9.3
NH_3-N	64.8	68.3	24.4	1.43	19.4	0.9	2.3
NO_2-N							
NO_3-N							
Phosphorus Total	51.8	232.1	17.1	0.6	53.8	0.2	0.5
Phosphorus Soluble	25.9	68.3	4.87	0.3	35	0.2	0.5
BOD	2592	2048	487.3	57	388.8	43.2	70
COD	3888	3583	2680	128	972	43.2	281
Fecal Coliforms	1102	81	88	40	124	4	16
Fecal Streptococci (count/100 ml)	793	72	1500	70	4	4	410
Phenolics (mg/day)	1.30		0.46	0.01	0.10		0.0
Suspended Solids VSS (%)	2592	3413	2193	399	324	0.86	117
Lead	104	54.6	19.5	1.14	5.2	0.7	1.9
Copper	52	13.7	4.9	0.3	1.3	0.2	0.5
Chromium	155.5	41	14.6	0.9	3.9	0.5	1.4
Iron	1205	355	9.75	5.3	19.4	0.3	0.9
Zinc	26	13.7	4.9	0.4	2.6	0.2	0.7
Mercury							

REACH C

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	28	30	32	34	55	63	65
TKN	1.2	536	59.6	56.2	0.86	16.0	90.7
NH_3-N	0.1		9.94	25.9	1.51	3.2	30.2
NO_2-N					0.3		
NO_3-N					33.26		
Phosphorus - Total	0.4	17.3	14.9	2.6	4.84	1.6	6.1
Phosphorus - Soluble	0.03	10.4	13.4	2.6	0.6	0.6	9.1
BOD	2.6	518	437.2	345.6	45.4	32	453.6
COD	5.2	1382	1152.6	777.6	196.6	127.9	2721.6
Fecal Coliforms	37000	80	94536	10	102	20	
Fecal Strepto-cocci (count/100 ml)	2600	140	2006	10	58	50	
Phenolics (mg/day)	0.00		0.02	0.02	0.01		0.018
Suspended Solids VSS (%)	136	1728	298.1	1080	831.6	159.8	1058.4
Lead	0.07	13.8	5.96	6.9	1.21	2.6	24.2
Copper	0.02	3.5	2.0	1.7	0.45	0.6	6
Chromium	0.05	10.4	6.0	5.2	0.91	1.9	18.1
Iron	1.2	15.5	22.4	345.6	2.62	1.3	12.1
Zinc	0.03	6.9	3.0	1.7	16.23	0.6	10.6
Mercury					0.53		

REACH C

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	435	523	525	531	535	537	
TKN	87.5	86.4	43.2	172.8	9.5	1036.8	
NH_3-N	19.4	21.6	21.6	43.2	0.22	172.8	
NO_2-N							
NO_3-N							
Phosphorus - Total	25.27	6.5	4.3	8.6	0.13	43.2	
Phosphorus - Soluble	9.7	4.3	4.3	8.6	0.09	34.6	
BOD	583.2	864	648	1296	8.64	2592	
COD	1166.4	3240	3034	5184	146.9	19872	
Fecal Coliforms	670	30	20	30	1600	620	
Fecal Strepto-cocci (count/100 ml)	770	110	210	110	7900	420	
Phenolics (mg/day)	0.04	0.13	0.17	0.26	0.02		
Suspended Solids VSS (%)	1263.6	3888	2592	6912	95	32832	
Lead	15.5	17.3	17.3	34.6	0.35	69.1	
Copper	3.9	4.3	4.3	8.6	0.13	17.3	
Chromium	11.7	13.0	13.0	25.9	0.26	51.8	
Iron	207	90.7	47.5	133.9	3.63	1209.6	
Zinc	8.75	4.34	4.3	8.6	0.13	17.3	
Mercury							

REACH C

TABLE A3C
Page 4 of 4

OUTFALL LOADING SHEET

Outfall / Parameter	Average Contaminant Loading (g/day)						
	Total A	*Total B*					
TKN	3165.4						
NH_3-N	283.3	247.9					
NO_2-N	0.30						
NO_3-N	33.26						
Phosphorus - Total	491.8						
Phosphorus - Soluble	183.7	*49.66*					
BOD	13513.5						
COD	50582						
Fecal Coliforms							
Fecal Strepto-cocci (count/100 ml)							
Phenolics (mg/day)	0.64	*0.08*					
Suspended Solids VSS (%)	73285.8						
Lead	3591.5	*392.7*					
Copper	0.58	*125.12*					
Chromium		*376.05*					
Iron	3664.3	*24.35*					
Zinc	46.31	*84.63*					
Mercury	0.53						

REACH D

TABLE A3D

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	29	31	33	36	37	38	39
TKN	16.9	4.9	26.7	28.0	81.5	3.5	82.9
NH_3-N	11.23	2.72	5.94	3.78	23.14	0.86	211.7
NO_2-N				1.01	5.51		6.9
NO_3-N				89.46	103.5		159
Phosphorus - Total	1966	20.39	14.84	41.13	7.13	0.52	1181.9
Phosphorus - Soluble	17.41	0.54	5.35	29.79	5.9	0.17	1047.2
BOD	140.4	244.9	16.55	317.5	95.47	17.3	1451.5
COD	224.6	639.5	594	816.5	190.9	17.3	3732.5
Fecal Coliforms	77	30	10	1052	56323	20	664
Fecal Strepto-cocci (count/100 ml)	115	240	70	943	8959	10	134
Phenolics (mg/day)		0.01	1.09		0.03		
Suspended Solids VSS (%)	196.6	843.7	267.3	472	80.8	129.6	2592
Lead	3.9	2.18	4.75	3.02	1.18	0.69	16.59
Copper	1.12	0.54	5.64	0.76	0.29	0.17	4.15
Chromium	32.57	1.63	3.56	2.27	0.88	0.52	404
Iron	2.25	17.8	8.02	3.4	0.73	0.35	354.1
Zinc	8.42	2.54	2.38	0.76	0.29	0.17	18.7
Mercury	0.95						

REACH D

TABLE A3D
Page 2 of 4

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	40	47	50	53	60	70	72
TKN	43.2	69.1	142.6	6.91	10.37	5.83	2.16
NH_3-N	8.64	8.64	13.0	0.86	3.24	1.94	0.86
NO_2-N							
NO_3-N							
Phosphorus - Total	0.26	22.5	48.0	6.0	5.83	1.37	1.04
Phosphorus - Soluble	0.1	10.37	18.14	2.6	1.56	0.98	0.52
BOD		345.6	259.2	17.3	25.9	19.4	8.64
COD		1296	1944	121	194.4	58.3	103.68
Fecal Coliforms	40	50	120	170	384	10	30
Fecal Strepto-cocci (count/100 ml)	70	380	680	290	240	530	310
Phenolics (mg/day)		0.05		0.01			
Suspended Solids VSS (%)		691	388.8	8.64	142.6	233.3	51.84
Lead		6.91	10.37	0.69	2.07	2.24	0.69
Copper		1.73	2.59	0.17	0.52	0.39	0.17
Chromium		5.18	7.78	0.52	1.56	1.17	0.52
Iron		3.46	5.18	0.35	1.04	0.78	1.25
Zinc		1.73	10.37	0.69	0.52	0.39	0.22
Mercury							

REACH D

TABLE A3D
Page 3 of 4

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	80	82	88	326	336	346	354
TKN	6.1	3.37	1.72	60.3	65	4.32	648
NH_3-N	1.51	1.1	0.48	13.4	2.2	2.2	129.6
NO_2-N							
NO_3-N							
Phosphorus - Total	0.46	0.56	0.1	2.0	0.2	0.22	129.6
Phosphorus - Soluble	0.30	0.56	0.1	2.7	0.43	0.43	90.72
BOD	15.1	11.2	4.8	241.1	21.6	21.6	5961.6
COD	181.4	56.2	21.38	1339.2	151.2	108	22810
Fecal Coliforms	10	10		57	50	70	1338
Fecal Strepto-cocci (count/100 ml)	10	10		335	30	20	2881
Phenolics (mg/day)	36.3	101.1					4.06
Suspended Solids VSS (%)	121	101.1	40.39	200.9	21.6	43.2	4536
Lead	1.21	0.90	0.38	10.7	1.73	1.73	103.7
Copper	0.3	0.22	0.1	2.68	0.43	0.43	25.9
Chromium	0.9	0.67	0.29	8.04	1.3	1.3	77.8
Iron	12.1	1.35	0.48	5.36	0.86	0.86	142.6
Zinc	0.3	0.22	0.1	3.35	2.81	0.43	51.8
Mercury							

REACH D

TABLE A3D
Page 4 of 4

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	448		Total A	*Total B*			
TKN	4.3		1311.7				
NH_3-N	*2.2*		252.03	*197.2*			
NO_2-N			13.42				
NO_3-N			351.96				
Phosphorus - Total	*0.22*		3449.66	*0.66*			
Phosphorus - Soluble	*0.43*		1231.23	*5.1*			
BOD	21.6		9323.1				
COD	64.8		34685.9				
Fecal Coliforms	10						
Fecal Strepto-cocci (count/100 ml)	10						
Phenolics (mg/day)			41.55				
Suspended Solids VSS (%)	21.6		11184.0				
Lead	*1.73*		2.24	*174.5*			
Copper	*0.43*		5.64	*43.6*			
Chromium	*1.3*		436.57	*117.1*			
Iron	3.24		544.7	*20.9*			
Zinc	*0.43*		97.9	*8.8*			
Mercury			0.95				

REACH E

TABLE A3E
Page 1 of 2

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	106	114	116	118	120	122	132
TKN	62.6	12.1	27.2	105.8	38.0	123.02	984.1
NH_3-N	13.2	19.01	3.9	10.6	6.9	55.12	820.8
NO_2-N	2.5						13.22
NO_3-N	223.3						90.72
Phosphorus - Total	257.5	5.5	1.56	16.4	9.68	0.95	43.55
Phosphorus - Soluble	9.0	24.2	0.78	10.58	3.46	0.73	1.56
BOD	308.5	86.4	77.8	266.1	649.7	108	349.9
COD	1348.4	501.1	777.6	1851	3067.2	752.5	1283
Fecal Coliforms	52571	1255	260	316	282	938	603
Fecal Strepto-cocci (count/100 ml)	1582	2934	190	79	2261	998	276
Phenolics (mg/day)	0.05	0.01			0.67		
Suspended Solids VSS (%)	749.1	155.2	38.9	2593	1624.3	165.2	2021.8
Lead	3.53	2.76	3.11	8.47	5.53	3.67	6.22
Copper	1.1	0.69	0.78	2.12	2.07	0.73	1.56
Chromium	2.64	2.07	2.33	6.35	4.15	2.2	4.67
Iron	3.75	2.59	5.83	52.4	46.0	5.88	114.31
Zinc	1.1	0.69	0.78	2.65	2.76	4.41	1.56
Mercury							

REACH E

TABLE A3E
Page 2 of 2

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	152	160	466		Total A	*Total B*	
TKN	71.3	8.71	51.8		1593.53		
NH_3-N	*11.9*	*2.18*	*17.3*		908.13	*52.78*	
NO_2-N					15.72		
NO_3-N					314.02		
Phosphorus - Total	13.66	0.54	*1.73*		349.34	*1.73*	
Phosphorus - Soluble	11.88	*0.43*	*3.46*		59.9	*6.18*	
BOD	3659.	87.1	345.6		5938.1		
COD	15515	544.3	1900.8		27540.9		
Fecal Coliforms	524	32	160				
Fecal Strepto-cocci (count/100 ml)	488	1336	600				
Phenolics (mg/day)		0.05			0.77	*0.01*	
Suspended Solids VSS (%)	2970	293.9			10961.5		
Lead	10.69	0.33	*13.82*		14.69	*43.44*	
Copper	*2.38*	*0.44*	*3.46*		3.17	*12.16*	
Chromium	*7.13*	*1.31*	*10.37*			*43.22*	
Iron	35.6	11.87	13.82		292.05		
Zinc	29.11	4.68	8.64		54.13	*2.25*	
Mercury							

REACH F

TABLE A3F
Page 1 of 2

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	162	164	170	180	184	198	204
TKN	2.64	82.3		20.2	2.6	0.26	13.0
NH_3-N	0.86	3.17	28.1	4.5	0.65	0.09	13.0
NO_2-N							
NO_3-N							
Phosphorus - Total	0.35	2.54	157.3	2.7	2.6	0.01	1.3
Phosphorus - Soluble	0.35	1.27	50.5	1.8	2.6	0.02	2.59
BOD	38.9	168.8	7301	108	194.4	1.73	129.6
COD	146.9	673.9	9547	529.6	518.4	10.37	259.2
Fecal Coliforms	152	42	80	2001	600	270	10
Fecal Strepto-cocci (count/100 ml)	1570	490	330	7081	30	150	10
Phenolics (mg/day)			3.88				
Suspended Solids VSS (%)	2.15	253	1123.2	157.3	64.8	16.4	518.4
Lead	0.08	5.07	44.9	3.6	5.18	0.07	10.4
Copper	0.02	1.27	11.2	0.9	1.3	0.02	2.6
Chromium	0.05	3.8	33.7	2.7	3.9	0.05	7.8
Iron	0.07	7.0	297.6	33.92	4.54	0.16	5.2
Zinc	0.14	1.27	28.1	0.9	1.94	0.02	2.6
Mercury							

REACH F

TABLE A3F
Page 2 of 2

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	318	320		Total A	*Total B*		
TKN	6.46	116.6		243.84			
NH_3-N	*0.99*	*19.44*			*69.9*		
NO_2-N							
NO_3-N							
Phosphorus - Total	1.19	19.44		186.12	*1.30*		
Phosphorus - Soluble	0.4	*38.9*		55.65	*7.75*		
BOD	9.94	194		8144.7			
COD	119.23	3689		15483.1			
Fecal Coliforms	100	90					
Fecal Strepto-cocci (count/100 ml)	120	80					
Phenolics (mg/day)				3.88			
Suspended Solids VSS (%)	24.8	1069		3229.0			
Lead	*0.79*	*15.6*		0.08	84.04		
Copper	*0.2*	*3.9*		0.02	*21.39*		
Chromium	*0.6*	*11.7*			*88.55*		
Iron	1.64	50.5		395.2	*5.20*		
Zinc	0.35	26.2		56.7	*477*		
Mercury							

REACH G

TABLE A3G
Page 1 of 3

OUTFALL LOADING SHEET

Outfall / Parameter	Average Contaminant Loading (g/day)						
	250	252	254	256	264	266	270
TKN	32.4	5.7	35.6	6.29	101.8	34.6	1227.7
NH_3-N	5.4	1.9	9.7	1.12	530	8.64	635
NO_2-N				0.3			
NO_3-N				79.4			
Phosphorus - Total	6.5	3.04	3.24	3.51	11.2	3.46	279.4
Phosphorus - Soluble	3.24	0.76	1.94	3.23	3.51	1.73	110.1
BOD	162	45.6	226.8	44.9	1516.2	172.8	4572
COD	432	72.2	745.2	95.5	4830	777.6	23031
Fecal Coliforms	5900	11335	68	510	1364	260	768
Fecal Streptococci (count/100 ml)	1500	4298	259	10	1302	60	2512
Phenolics (mg/day)					0.08		2.58
Suspended Solids VSS (%)	270	48.6	259.2	28.1	596.7	259.2	8467
Lead	4.32	1.52	5.18	0.9	33.4	6.91	68
Copper	1.08	0.38	1.3	0.02	1.4	1.73	17
Chromium	3.24	1.14	3.89	0.05	4.21	5.18	51
Iron	14.04	0.76	39.85	0.45	62.5	10.4	1270.0
Zinc	1.08	1.90	7.78	1.68	9.83	23.3	122.8
Mercury							

REACH G

TABLE A3G

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	376	378	382	384	500	502	504
TKN	3.46	2.6	1.73	17.3	25.9	2592	2592
NH_3-N	0.86	0.86	0.86		19.35	518.4	345.6
NO_2-N					2.16	220.3	241.9
NO_3-N					43.2	1296	1555.2
Phosphorus - Total	0.17	0.69	1.73	0.43	2.16	1399.7	3404.2
Phosphorus - Soluble	0.17	0.52	1.73	1.3	0.43	285.1	1693.4
BOD	17.3	22.5	43.2	64.8	129.6	22032	13824
COD	34.6	122.7	69.1	237.6	11448	300672	148608
Fecal Coliforms	5500	25210	2300	1500	1000	110	7800
Fecal Streptococci (count/100 ml)	2900	16506	3100	290	310	440	25000
Phenolics (mg/day)					0.81	35.09	79.12
Suspended Solids	8.6	129.6	60.5	21.6	2462	358992	368064
VSS (%)					33	34.3	34.3
Lead	0.69	0.69	0.69	1.73	0.43	466.6	380.2
Copper	0.17	0.17	0.17	4.3	1.30	116.6	103.7
Chromium	0.52	0.52	0.52	1.30	0.43	2851	86.4
Iron	0.52	.035	3.72	6.05	90.7	13349	4147
Zinc	0.17	.017	0.17	0.12	1.94	7905.6	449.3
Mercury							

REACH G

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	Total A	*Total B*					
TKN	6679.1						
NH_3-N	2058.05	*19.64*					
NO_2-N	464.66						
NO_3-N	2973.80						
Phosphorus Total	5119.4						
Phosphorus Soluble	2143.3	*3.89*					
BOD	42874						
COD	491176						
Fecal Coliforms							
Fecal Strepto-cocci (count/100 ml)							
Phenolics (mg/day)	117.68						
Suspended Solids	5739667.10						
VSS (%)	34						
Lead	880.20	*91.1*					
Copper	116.60	*132.7*					
Chromium	2937.40	*72.0*					
Iron	18994	*1.6*					
Zinc	8524.1	*1.71*					
Mercury							

REACH H

TABLE A3H
Page 1 of 4

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	441	443	445	449	451	455	459
TKN	58.3	25.9	75.6	18.14	23.3	64.8	10.37
NH_3-N	7.78	4.32	15.1	2.59	3.89	12.96	2.59
NO_2-N							
NO_3-N							
Phosphorus - Total	1516	1.3	6.05	1.04	1.75	48.6	10.89
Phosphorus - Soluble	1516	0.86	3.02	1.04	1.17	19.44	0.52
BOD	777.6	86.4	604.8	129.6	97.2	324	103.7
COD	1749.6	1382.4	2116.8	440.64	699.8	131.2	388.8
Fecal Coliforms	10	10	20	40	1482	4695	40
Fecal Strepto-cocci (count/100 ml)	160	845	590	180	693	32.9	530
Phenolics (mg/day)	0.04			0.06	0.05	0.1	
Suspended Solids VSS (%)	972	64.8	302.4	311	136.08	129.6	77.8
Lead	15.5	3.46	12.1	2.07	3.1	10.37	2.07
Copper	4.86	0.86	3.02	0.52	0.78	2.59	0.52
Chromium	7.79	2.59	9.07	1.56	2.33	7.78	1.56
Iron	25.27	6.26	31.75	12.44	34.02	11.02	9.59
Zinc	7.81	1.08	28.73	7.26	7.39	16.85	5.7
Mercury							

REACH H

TABLE A 3H
Page 2 of 4

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	463	465	469	471	473	475	477
TKN	140.0	19.44	8.64	362.9	16.42	3.46	86.4
NH_3-N	4.67	13	2.16	60.5	6.91	0.86	86.4
NO_2-N							
NO_3-N							
Phosphorus - Total	1.40	1.94	0.22	51.4	0.95	0.17	77.76
Phosphorus - Soluble	0.93	5.18	0.87	18.1	0.52	0.17	17.3
BOD	140.0	518.4	43.2	3024	43.2	8.64	864
COD	559.9	1231.2	194.4	8769.6	691.2	60.5	6912
Fecal Coliforms	100	2683	20	655	40	340	20
Fecal Strepto-cocci (count/100 ml)	40	107	20	300	182	160	40
Phenolics (mg/day)				0.99	0.01		
Suspended Solids	513.2	194	21.6	18446	155.2	60.5	2592
VSS (%)							
Lead	3.73	10.37	1.73	48.4	1.38	0.69	69.1
Copper	0.93	2.59	0.43	12.1	0.35	0.17	17.3
Chromium	2.8	7.78	1.30	36.3	1.04	0.52	51.8
Iron	31.73	7.78	0.86	48.4	65.9	1.4	35.6
Zinc	3.73	9.72	1.08	72.58	54.6	0.86	112.3
Mercury					3.46		

REACH H

TABLE A3H
Page 3 of 4

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	479	481	483	677	679		
TKN	1.27	21963.7	28.51	17.28	34.56		
NH_3-N	0.24	21962.7	4.75				
NO_2-N	0.52						
NO_3-N	6.0						
Phosphorus - Total	0.13	26355.6	1.43	1.73	1.73		
Phosphorus - Soluble	0.73	439.2	0.95	1.73	1.73		
BOD	4.84	439258	47.5	86.4	259.2		
COD	43.55	2635545	427.7	345.6	604.8		
Fecal Coliforms	20	20	10	50	330		
Fecal Strepto-cocci (count/100 ml)	380	20	10	2200	230		
Phenolics (mg/day)							
Suspended Solids VSS (%)	21.8	878515	142.6	86.4	1382.4		
Lead	0.19	17570.3	3.8	6.91	6.91		
Copper	0.05	4392.5	6.18	1.73	1.73		
Chromium	0.15	13177.7	2.85	5.18	5.18		
Iron	0.10	39533.2	66.5	3.41	39.7		
Zinc	2.06	19766.6	3.33	3.46	1.73		
Mercury							

REACH H

TABLE A3H

OUTFALL LOADING SHEET

Outfall / Parameter	Average Contaminant Loading (g/day)						
	With #481	Total A	*Total B*	Without #481		Total A	*Total B*
TKN		22958				995.3	
NH_3-N		101.1	*22090*			101.1	*127.6*
NO_2-N			*0.52*				
NO_3-N		6.0				6.0	
Phosphorus - Total		28080				1724.5	
Phosphorus - Soluble		1563.2	*4419.54*			1563.2	*27.04*
BOD		445643				6385	
COD		2653525				17980	
Fecal Coliforms							
Fecal Strepto-cocci (count/100 ml)							
Phenolics (mg/day)		1.21	*0.04*			1.21	*0.04*
Suspended Solids VSS (%)		901124				22609	
Lead			*17772*				*201.9*
Copper		6.18	*4443*			6.18	*50.53*
Chromium			*13325*				*147.6*
Iron		39888.7	*76.26*			355.1	*76.26*
Zinc		20097.3	*9.54*			330.73	*9.54*
Mercury			*3.46*				*3.46*

REACH I

TABLE A31
Page 1 of 2

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	208	218	220	230	244	392	460
TKN	39.05	21.6	61.6	32.4	1302.3	12.96	7.8
NH_3-N	18.36	5.4	10.26	6.48	755.14	4.3	0.86
NO_2-N					43.78		
NO_3-N					1076.2		
Phosphorus - Total	5.51	1.62	28.22	9.4	149.93	1.51	0.78
Phosphorus - Soluble	5.51	1.08	2.06	1.3	35.0	1.30	0.52
BOD	229.5	189.22	328.3	162	1778.4	108	17.3
COD	1054	567.0	1149.1	583.2	13898.9	194.4	69.1
Fecal Coliforms	852	176	4521	150	2915	5300	890
Fecal Strepto-cocci (count/100 ml)	818	178	2024	236	1145	5800	1120
Phenolics							
Suspended Solids VSS (%)	91.8	81	564.3	259.2	16405	108	34.6
Lead	7.34	4.32	8.21	5.18	35.79	1.73	0.69
Copper	1.84	1.08	2.05	1.3	10.94	0.43	0.17
Chromium	5.51	3.24	6.16	3.89	26.7	1.3	0.52
Iron	5.51	4.32	25.7	4.54	730.1	0.86	0.35
Zinc	1.84	1.62	3.08	1.62	19.26	0.43	0.52
Mercury							

REACH I

TABLE A3I
Page 2 of 2

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	Total A	*Total B*					
TKN	1470						
NH_3-N	777.8	*22.14*					
NO_2-N	43.78						
NO_3-N	1076.2						
Phosphorus - Total	196.2						
Phosphorus - Soluble	41.81	*4.44*					
BOD	2795.4						
COD	17446.2						
Fecal Coliforms							
Fecal Strepto-cocci (count/100 ml)							
Phenolics							
Suspended Solids	22588						
VSS (%)							
Lead		*62.57*					
Copper		*17.64*					
Chromium		*46.8*					
Iron	770.2	*0.86*					
Zinc	25.58	*2.27*					
Mercury							

REACH J

TABLE A3J
Page 1 of 2

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)					
	134	138	140	142	146	148
TKN	155.5	118.8	57.8	70.2	5.18	33.26
NH_3-N	17.3	10.8	11.6	5.4	0.9	6.0
NO_2-N						
NO_3-N						
Phosphorus - Total	50.1	243	82.0	45.4	49.6	
Phosphorus - Soluble	6.9	28.1	11.6	20.5	6.7	
BOD	2073.6	345.6	346.5	432	145.2	
COD	2419	1641.6	808.7	1296	314.5	
Fecal Coliforms	10	180	90	1140	10	6148
Fecal Strepto-cocci (count/100 ml)	30	510	760	660	10	3960
Phenolics						
Suspended Solids VSS (%)	1209.6	432	577.8	1350	43.2	302.4
Lead	13.8	8.6	9.24	4.32	0.69	4.84
Copper	3.5	2.2	3.47	1.08	0.17	1.21
Chromium	10.4	6.5	66.25	3.24	0.52	3.63
Iron	6.9	13.0	681.8	42.12	0.35	3.02
Zinc	5.2	2.2	29.28	0.54	0.17	2.42
Mercury			28.31			

REACH J

TABLE A3J
Page 2 of 2

OUTFALL LOADING SHEET

Outfall / Parameter	Average Contaminant Loading (g/day)						
			Total A	*Total B*			
TKN			440.74				
NH_3-N				*52.0*			
NO_2-N							
NO_3-N							
Phosphorus - Total			470.1				
Phosphorus - Soluble			73.8				
BOD			3342				
COD			6479.8				
Fecal Coliforms							
Fecal Strepto-cocci (count/100 ml)							
Phenolics							
Suspended Solids VSS (%)			3915				
Lead				*50.73*			
Copper			3.47	*8.16*			
Chromium			66.25	*24.29*			
Iron			739.9	*7.25*			
Zinc			36.9	*2.91*			
Mercury			28.31				

REACH K

TABLE A 3K
Page 1 of 2

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	186	190	192	194	196	424	
TKN	138.2		19.01	155.5	6.48		
NH_3-N	8.64	30.24	4.75	25.9	2.16		
NO_2-N						2263.7	
NO_3-N							
Phosphorus - Total	13.8		0.95	23.3	0.43	A905.5	
Phosphorus - Soluble	1.73	6.05	0.95	15.55	0.43	905.5	
BOD	86.4	2419.2	285.1	518.4	64.8	67910	
COD	518.4	13003	807.8	3888	172.8	588557	
Fecal Coliforms	450	210	10	110	10	90	
Fecal Strepto-cocci (count/100 ml)	350	510	50	170	10	130	
Phenolics							
Suspended Solids	142	2419.2	142	2851	345.6	2082586	
VSS (%)							
Lead	6.91	24.19	3.80	20.74	1.73	1810.9	
Copper	1.73	6.05	0.95	5.18	0.43	452.7	
Chromium	5.18	18.14	2.85	15.55	1.3	1358.2	
Iron	3.46	30.24	10.93	570.2	4.32	56592	
Zinc	1.73	6.05	0.95	5.18	0.43	452.74	
Mercury							

(A) = Approximately

REACH K

TABLE A 3K
Page 2 of 2

OUTFALL LOADING SHEET

Outfall / Parameter	Average Contaminant Loading (g/day)						
	With#424	Total A	*Total B*	Without#424	Total A	*Total B*	
TKN		319.2			319.2		
NH_3-N			*2335.4*			*71.7*	
NO_2-N							
NO_3-N							
Phosphorus - Total		943.95			38.48		
Phosphorus - Soluble		905.47	*9.66*		15.55	*9.66*	
BOD		71284.3			3373.9		
COD		606946.8			18390		
Fecal Coliforms							
Fecal Strepto-cocci (count/100 ml)							
Phenolics							
Suspended Solids VSS (%)		2088486			5899.8		
Lead			*1868.3*			*57.37*	
Copper			*467.1*			*14.34*	
Chromium			*1401.2*			*43.02*	
Iron		57207.7	*3.46*			*3.46*	
Zinc			*467.1*			*14.34*	
Mercury							

REACH L

TABLE A3L
Page 1 of 4

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	67	69	71	75	83	85	87
TKN	1.56	269.15	143.08	133.06	409.9	83.9	3.21
NH_3-N	0.26	156.30	58.89	114.57	367.7	11.82	0.71
NO_2-N		15.03	7.85	6.65	133.2	0.13	1.75
NO_3-N		149.31	69.67	3.74	18.4	1.31	2.12
Phosphorus - Total	0.88	38.57	62.58	12.8	17.8	43.79	85.53
Phosphorus - Soluble	0.78	19.43	35.34	10.89	5.8	18.49	8.13
BOD	7.8	788.8	916.7	105.4	172.8	4331	2893.5
COD	67.4	1832	2604.1	293.8	1106	6012	4384.1
Fecal Coliforms	120	516769	25944	626039	170	136302	74632
Fecal Streptococci (count/100 ml)	10	21704	664	7271	92	2326	507
Phenolics (mg/day)			0.32		0.83	0.18	0.062
Suspended Solids VSS (%)	23.3	798.9	331.8	103.7	1235.5	280.8	336.5
Lead	0.21	2.78	1.33	0.69	2.76	1.05	0.57
Copper	0.05	2.43	1.00	0.22	0.7	0.26	0.81
Chromium	0.16	2.08	1.00	0.52	2.08	0.26	0.43
Iron	8.04	16.0	4.31	0.56	760.3	3.68	2.41
Zinc	0.05	2.43	2.16	0.22	1.6	1.31	0.35
Mercury							

REACH L

TABLE A 3L
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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	89	93	97	105	109	123	125
TKN	8.64	69.12	163.3	17.28	496.8	5635.6	1071.5
NH_3-N	2.16	17.28	46.66	4.32	86.4	833.8	349.9
NO_2-N						5.91	0.93
NO_3-N						9.52	2.02
Phosphorus - Total	0.65	51.8	21	3.46	103.68	1121.5	178.8
Phosphorus - Soluble	0.43	3.46	14	3.46	64.8	849.4	69.36
BOD	21.6	172.8	1166.4	43.2	3110.4	40294	6479
COD	129.6	864	2566.1	302.4	7776	82533	14560
Fecal Coliforms	10	220	1554	580	5446	500219	1235611
Fecal Strepto-cocci (count/100 ml)	10	50	165	390	1446	810376	465390
Phenolics (mg/day)		0.07	0.09	0.01		3.22	2.15
Suspended Solids	86.4	1036.8	3499	43.2	3276	118329	3095
VSS (%)						38.9	85
Lead	1.73	13.82	37.32	3.46	34.56	1.7	3.62
Copper	0.43	3.46	43.16	0.86	17.28	1.4	0.78
Chromium	1.3	10.37	27.99	2.59	25.92	0.55	1.01
Iron	1.08	8.64	73.48	2.59	75.6	71.6	56.76
Zinc	0.43	15.55	769.8	1.30	15.12	7.92	4.04
Mercury			16.3			2.51	0.86

REACH L

TABLE A3L
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OUTFALL LOADING SHEET

Outfall / Parameter	Average Contaminant Loading (g/day)						
	127	129	135	139	145	147	151
TKN	1166.4	993.6	220.3	5061.5	15.55	102.9	25.9
NH_3-N	345.6	820.8	25.92	5934	0.43	73.5	20.74
NO_2-N				8.81			
NO_3-N				205.63			
Phosphorus Total	99.36	432	88.13	26.44	0.09	12.87	0.60
Phosphorus Soluble	17.28	263.5	59.62	8.81	0.09	9.56	0.17
BOD	4752	2592	907.2	2203.2	4.32	110.3	34.6
COD	23328	13176	2332.8	11457	30.24	661.73	155.5
Fecal Coliforms	759	2857	14748	232	10	190	530
Fecal Strepto-cocci (count/100 ml)	1190	2795	1776	22	10	30	280
Phenolics (mg/day)	0.60	0.13	0.83	0.84			0.01
Suspended Solids	71539	441	2980.8	3378	8.64	73.53	509.8
VSS (%)	56						
Lead	69.12	34.56	20.74	23.5	0.35	2.94	0.69
Copper	17.3	8.64	5.18	5.88	0.09	0.74	0.17
Chromium	51.8	25.92	15.55	17.6	0.26	2.21	0.52
Iron	976.3	162	44.06	866.6	1.12	9.56	85.5
Zinc	30.24	12.96	5.18	5.88	0.09	0.74	0.43
Mercury							

REACH L

TABLE A3L
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OUTFALL LOADING SHEET

Outfall / Parameter	Average Contaminant Loading (g/day) 165	169	557	607		Total A	*Total B*
TKN	233.8		155.2	12.96		16494	
NH_3-N	53.14		77.76	*4.32*		9304.9	*102.21*
NO_2-N						180.13	*0.13*
NO_3-N						460.88	*1.31*
Phosphorus - Total	14.88		36.29	0.86		2394.36	
Phosphorus Soluble	6.38		23.33	*0.86*		1471.51	*21.86*
BOD	1062.7		259.2	86.4		72515	
COD	420.4		2592	302.4		200482	
Fecal Coliforms	4479	10	20	40			
Fecal Strepto-cocci (count/100 ml)	2452	120	20	30			
Phenolics (mg/day)	0.13			*0.01*		9.38	*0.11*
Suspended Solids	2019.2		1944	259.2		215629	
VSS (%)						39.9	
Lead	*17.00*		*10.37*	*3.46*		5.32	*283.01*
Copper	*4.25*		*2.59*	*0.86*		67.34	*51.2*
Chromium	*12.75*		*7.78*	*2.59*		1.56	*211.94*
Iron	68.01		207.6	12.53		3518	
Zinc	8.5		2.59	8.21		884.7	*12.37*
Mercury						18.81	

Gartner Lee Associates Limited

REACH M

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	171	173	175	177	179	181	185
TKN	77.8	93.3	276.5	32.4	45.6	36.72	20.41
NH_3-N	13.0	46.7	103.7	10.8	20.53	2.16	3.24
NO_2-N							
NO_3-N							
Phosphorus - Total	70.0	8.55	6.91	2.16	2.57	6.05	5.83
Phosphorus - Soluble	64.8	6.22	6.91	0.86	0.57	1.3	1.3
BOD	324	272.2	2073.6	151.2	285.1	183.6	145.8
COD	1296	1594	3110.4	777.6	741.3	367.2	307.8
Fecal Coliforms	4000	30	1700	114	13927	122789	1117
Fecal Streptococci (count/100 ml)	200	90	680	110	2385	20572	4948
Phenolics							
Suspended Solids	194.4	2663.3	1728	151.2	327.9	194.4	32.4
VSS (%)		35.3					
Lead	5.18	3.11	27.65	3.46	2.28	1.73	2.59
Copper	1.30	0.78	6.91	0.86	0.57	0.43	0.65
Chromium	3.89	2.33	20.74	2.59	1.71	1.3	1.94
Iron	6.48	124.4	13.82	44.06	27.35	5.4	1.3
Zinc	1.94	0.78	10.37	2.59	2.14	0.43	0.65
Mercury							

REACH M

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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	191	193	195	197	207	209	213
TKN	83.81	2332	28.51	5.18	38.9	2122.4	49.25
NH_3-N	50.28	1607	4.75	0.86	13.0	245.3	36.12
NO_2-N		138.2				51.41	
NO_3-N		2851				477.4	
Phosphorus - Total	3.35	198.7	0.95	0.35	2.59	55.63	6.89
Phosphorus Soluble	3.35	34.56	0.95	0.35	2.59	16.52	0.98
BOD	8615.5	8467	237.6	17.28	259.2	2937.6	32.83
COD	17918.2	25920	950.4	129.6	777.6	18727	816.7
Fecal Coliforms	49	7305	10	20	100	1500	316
Fecal Strepto-cocci (count/100 ml)	182	3079	80	60	470	1700	101
Phenolics (mg/day)		5.85				1.59	0.01
Suspended Solids	1341	17280	142.6	103.7	129.6	8078.4	2462.4
VSS (%)							26.8
Lead	6.70	69.1	3.8	0.69	10.37	187.27	1.31
Copper	1.68	17.28	0.95	0.17	2.59	7.34	0.33
Chromium	5.03	51.84	2.85	0.52	7.78	22.03	0.98
Iron	570	1374	66.53	1.73	59.62	771.1	1067.4
Zinc	3.35	38.88	0.95	0.53	2.59	51.41	12.56
Mercury							0.98

REACH M

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	215	217	219	587	589		
TKN	25.92	160.1	28.51	103.7	864		
NH_3-N	8.64	28.08	2.59	34.56	712.8		
NO_2-N							
NO_3-N							
Phosphorus - Total	4.32	23.87	2.85	41.47	8.64		
Phosphorus - Soluble	0.86	8.42	0.52	13.82	4.32		
BOD	43.2	702	764.6	1036.8	2160		
COD	302.4	2106	1445.0	1036.8	7776		
Fecal Coliforms	10	219	163	10	750		
Fecal Strepto-cocci (count/100 ml)	20	684	217	330	750		
Phenolics (mg/day)	0.03		0.07	0.14			
Suspended Solids	129.6	702	207.4	1382.4	5615		
VSS (%)							
Lead	3.46	22.46	2.07	27.65	17.28		
Copper	0.86	5.62	0.52	6.91	4.32		
Chromium	2.59	16.85	1.56	20.74	12.98		
Iron	3.02	127.76	21.51	13.82	280.8		
Zinc	0.86	7.02	0.52	20.74	4.32		
Mercury							

REACH M

TABLE A 3M
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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	Total A	*Total B*					
TKN	6425.01						
NH_3-N	2854.87	*89.27*					
NO_2-N	189.61						
NO_3-N	3328.4						
Phosphorus - Total	706.11						
Phosphorus - Soluble	151.62	*17.58*					
BOD	28709.11						
COD	86100.0						
Fecal Coliforms							
Fecal Strepto-cocci (count/100 ml)							
Phenolics (mg/day)	7.69						
Suspended Solids	43157.3						
VSS (%)	30.1						
Lead	187.27	*210.89*					
Copper		*60.07*					
Chromium		*180.23*					
Iron	4099.2	*28.94*					
Zinc	151.53	*11.10*					
Mercury	0.98						

REACH N

TABLE A3N

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	221	225	227	229	237	241	
TKN	4.32	2808.0	37.80	12.10	190.08	19.44	
NH_3-N	1.73	864.0	10.80	6.05	30.24	2.59	
NO_2-N							
NO_3-N							
Phosphorus -- Total	0.17	194.4	6.48	0.91	12.53	126.49	
Phosphorus -- Soluble	0.17	129.6	4.32	1.21	3.46	1.30	
BOD	34.6	21600.0	432.0	193.5	1080.0	77.8	
COD	77.8	58320.0	756.0	520.1	1468.8	220.3	
Fecal Coliforms	520	2200	30	40	15627	1500	
Fecal Strepto-cocci (count/100 ml)	240	600	80	160	3046	890	
Phenolics (mg/day)	[illegible]		0.04		0.35	0.02	
Suspended Solids VSS (%)	9	10800	324	333	518	39	
Lead	0.69	345.60	8.64	4.84	6.91	2.07	
Copper	0.17	86.40	2.16	1.21	1.73	0.52	
Chromium	0.52	259.20	6.48	3.63	5.18	1.56	
Iron	1.21	367.20	16.74	31.45	9.50	1.04	
Zinc	0.17	108.00	2.16	1.21	3.46	0.65	
Mercury							

REACH N

TABLE A 3N
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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	247	253	255	265	269	271	275
TKN	208.66	24.19	43.20	64.80	708.22	12.10	0.52
NH_3-N	*18.14*	8.64	*8.64*	*12.96*	107.05	5.18	*0.86*
NO_2-N					3.93		
NO_3-N					39.31		
Phosphorus Total	107.05	2.42	5.18	7.78	34.29	0.86	0.17
Phosphorus Soluble	*3.63*	0.69	3.46	*2.59*	23.59	0.35	0.35
BOD	725.8	*8.6*	259.2	388.8	332.6	*8.6*	*8.6*
COD	3338.5	276.5	1209.6	6350.4	164.0	146.9	95.0
Fecal Coliforms	6830	10	760	380	168365	900	90
Fecal Streptococci (count/100 ml)	1278	250	800	660	70449	100	230
Phenolics (mg/day)		0.01					
Suspended Solids	47574	467	346	1166	484	43	17
VSS (%)	62.6						
Lead	16.33	*0.69*	*6.91*	*10.37*	*2.42*	*0.69*	*0.69*
Copper	*3.63*	*0.17*	*1.73*	*2.59*	*0.60*	*0.17*	0.69
Chromium	*10.89*	*0.52*	*5.18*	*7.78*	*1.81*	*0.52*	*0.52*
Iron	3204.23	112.32	23.33	46.66	3.33	0.78	0.69
Zinc	13.61	0.69	3.46	15.55	1.06	0.52	0.35
Mercury		0.39					

REACH N

TABLE A 3N
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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	277	603	605	739	741	Total A	*Total B*
TKN	75.82	34.56	177.12	388.80	216.00	5025.73	
NH_3-N	*11.66*	*8.64*	129.60	86.40	86.40	1319.24	*80.34*
NO_2-N				47.52	60.48	111.93	
NO_3-N				1036.80	475.20	1551.31	
Phosphorus - Total	2.33	1.73	8.64	69.12	25.92	606.47	
Phosphorus - Soluble	15.16	*1.73*	2.59	17.28	*8.64*	202.15	*17.97*
BOD	466.6	432.0	691.2	7344	5616	39674	*25.8*
COD	1807.9	691.2	734.4	139968	172800	388945	
Fecal Coliforms	14	1300	7600	10	10		
Fecal Strepto-cocci (count/100 ml)	282	430	200	230	270		
Phenolics (mg/day)		*0.02*		20.30	26.78	47.50	*0.02*
Suspended Solids	525	*86*	173	252720	28944	344473	*95*
VSS (%)				35	39	35.7	
Lead	*9.33*	*6.91*	*3.46*	125.28	69.12	210.73	*410.22*
Copper	*2.33*	*1.73*	*0.86*	30.24	25.92	56.85	*106.00*
Chromium	*7.00*	*5.18*	*2.59*	*17.28*	*8.64*		*344.48*
Iron	25.66	*3.46*	*1.73*	2980.80	1188.0	8011.9	*6.23*
Zinc	17.50	*1.73*	*0.86*	103.68	*90.72*	268.53	*96.85*
Mercury						0.39	

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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	279	281	289	293	301	307	309
TKN	417.31	20.09	97.20	4.75	553.39	12.96	200.88
NH_3-N	*36.29*	57.67	6.48	2.59	*45.36*	*4.32*	51.84
NO_2-N		1.40			10.58		
NO_3-N		141.48			493.52		
Phosphorus - Total	257.64	181.44	2.38	0.65	1287.32	5.18	14.26
Phosphorus - Soluble	65.32	6.48	*0.86*	0.26	1242.86	*0.86*	11.66
BOD	7547.9	140.40	86.4	51.8	6577.2	129.6	518.4
COD	18724.6	427.7	712.8	86.4	21546.0	216.0	1490.4
Fecal Coliforms	266	24	286	203	42	10	4938
Fecal Strepto-cocci (count/100 ml)	11393	83	57	541	83	10	769
Phenolics (mg/day)	42.37	0.03					0.05
Suspended Solids VSS (%)	6532	302	216	125	1588	173	778
Lead	38.10	9.07	*3.46*	*0.69*	*36.29*	*3.46*	16.20
Copper	*7.26*	*1.73*	6.70	*0.17*	*9.07*	*0.86*	*2.59*
Chromium	*21.77*	*5.18*	*2.59*	*0.52*	*27.22*	*2.59*	*7.78*
Iron	281.23	9.94	53.14	13.82	163.30	11.66	53.14
Zinc	59.88	3.46	1.73	0.22	34.02	1.30	5.18
Mercury							

REACH 0

TABLE A3 0
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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	325	337	339	341	345	365	367
TKN	30.24	4.32	332.64	302.40	1.04	6.05	1555.20
NH_3-N	4.32	0.86	47.52	45.36	0.39	0.86	259.20
NO_2-N							
NO_3-N							
Phosphorus - Total	1.30	0.39	299.38	24.19	0.15	0.78	505.44
Phosphorus - Soluble	0.86	0.26	190.08	9.07	0.02	0.17	311.04
BOD	388.8	21.60	1900.8	7318.1	2.6	8.6	5184.0
COD	1728.0	86.4	5227.2	20623.7	13.8	60.5	22032
Fecal Coliforms	1820	725	220	4077	64	640	300
Fecal Strepto-cocci (count/100 ml)	1844	30	10	1498	39	60	80
Phenolics (mg/day)				0.06			
Suspended Solids VSS (%)	194	60	4752	6804	23	43	10368
Lead	3.46	0.69	38.02	24.19	0.07	0.69	103.68
Copper	0.86	0.17	9.50	6.05	0.02	0.17	25.19
Chromium	9.07	0.52	28.41	18.14	0.05	0.52	77.76
Iron	7.78	2.42	90.29	114.91	2.12	0.35	375.84
Zinc	5.62	0.56	61.78	13.61	0.02	0.95	25.92
Mercury							

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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	369	371	373	639	641	653	657
TKN	20.91	1568.16	34.56	207.36	69.12	51.84	25.92
NH_3-N	0.48	28.51	8.64	51.84	17.28	8.64	8.64
NO_2-N							
NO_3-N							
Phosphorus -- Total	2.09	817.34	3.46	15.55	46.66	10.37	1.73
Phosphorus -- Soluble	0.19	47.52	1.73	10.37	3.46	1.73	1.73
BOD	33.3	7888.3	86.4	777.6	172.8	432.0	86.4
COD	152.1	23791.7	604.8	1555.2	691.2	1296.0	518.4
Fecal Coliforms	6700	11713	10	710	320	1500	10
Fecal Strepto-cocci (count/100 ml)	5200	398	10	540	50	400	90
Phenolics (mg/day)		1.05				0.09	
Suspended Solids	162	5766	259	1296	691	3283	173
VSS (%)		98					
Lead	0.43	7.60	6.91	20.74	13.82	6.91	6.91
Copper	0.19	1.90	1.73	5.18	3.46	1.73	1.73
Chromium	0.29	5.70	5.18	15.55	10.37	5.18	5.18
Iron	15.21	3.04	3.46	10.37	10.37	216.00	3.46
Zinc	2.71	11.40	1.73	5.18	3.46	6.05	6.91
Mercury							

REACH 0

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OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	659	699	701	703	715	Total A	*Total B*
TKN	51.84	3.46	0.35	6.48	7.78	5586.25	
NH_3-N	*8.64*	1.73	*0.09*	*2.16*	*0.86*	505.61	*194.96*
NO_2-N		0.35	0.03	*0.22*	0.60	12.96	*0.22*
NO_3-N		31.97	0.52	15.12	20.74	703.35	
Phosphorus - Total	1.73	0.26	0.04	0.65	1.38	3481.76	
Phosphorus - Soluble	*1.73*	*0.17*	*0.02*	*0.43*	*0.17*	1895.11	*13.94*
BOD	*8.64*	17.3	1.7	*21.6*	103.7	39207.9	*375.8*
COD	518.4	1503.4	24.2	907.2	1728.0	126266	
Fecal Coliforms	40	2700	10	20	3400		
Fecal Strepto-cocci (count/100 ml)	30	26000	70	20	4400		
Phenolics (mg/day)		0.01	0.01	0.01	0.09	43.71	*0.06*
Suspended Solids	86	156	6	65	346	44247	
VSS (%)		53.4	60.0	100	72.6	71.7	
Lead	*6.91*	1.99	*0.03*	*1.30*	4.06	69.85	*285.83*
Copper	*1.73*	0.26	*0.01*	*0.22*	0.43	7.58	*82.06*
Chromium	*5.18*	*0.09*	*0.01*	*0.22*	0.43	9.57	*246.10*
Iron	6.05	5.36	1.94	9.94	21.17	1468.67	*17.64*
Zinc	1.73	1.81	0.15	11.66	2.07	232.82	*36.29*
Mercury							

REACH P

TABLE A3P

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	379	381	383	385	387	393	395
TKN	8.64	285.12	677.38	559.87	5.62	1300.46	1224.72
NH_3-N	2.16	285.12	96.77	41.47	1.12	515.57	670.68
NO_2-N						98.50	
NO_3-N						2565.00	
Phosphorus - Total	0.43	32.40	43.55	31.10	0.34	176.99	297.43
Phosphorus - Soluble	0.43	147.74	29.03	8.29	0.34	73.10	124.14
BOD	21.6	259.2	6483.5	10948.6	38.2	12235.1	3499.2
COD	151.2	648.0	15966.7	17086.5	256.1	27240.3	8748.0
Fecal Coliforms	10	10	3150	106	4113	26714	11056
Fecal Strepto-cocci (count/100 ml)	10	10	1545	881	20256	5471	1647
Phenolics (mg/day)			1.84	0.33		0.54	0.12
Suspended Solids VSS (%)	173	907	9677	3525	34	14159	1458
Lead	1.73	10.37	38.71	33.18	0.90	75.10	46.66
Copper	0.43	2.59	9.68	8.29	0.22	12.31	11.66
Chromium	1.30	7.78	29.03	24.88	0.67	36.94	34.99
Iron	1.30	220.32	142.73	82.94	2.19	198.75	37.91
Zinc	0.43	0.43	33.87	20.74	7.64	47.49	40.82
Mercury						21.55	

REACH P

TABLE A3P
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OUTFALL LOADING SHEET

Outfall / Parameter	Average Contaminant Loading (g/day)						
	397	399	405		Total A	*Total B*	
TKN	4.32	432.99	77.76		4575.89		
NH_3-N	*0.86*	*86.40*	*17.28*		1568.14	*149.29*	
NO_2-N					98.50		
NO_3-N					2565.00		
Phosphorus - Total	0.22	177.12	31.97		791.55		
Phosphorus - Soluble	*0.17*	25.92	17.28		427.55	*8.89*	
BOD	25.9	2160.0	604.8		36276.1		
COD	60.5	10368.0	1555.2		32080.5		
Fecal Coliforms	447	1374	400				
Fecal Streptococci (count/100 ml)	1075	3100	279				
Phenolics (mg/day)		*0.17*			2.71	*0.29*	
Suspended Solids VSS (%)	*9*	1296	432		31661	*9*	
Lead	0.69	69.12	13.82		75.10	*215.18*	
Copper	*0.17*	*17.28*	*3.46*			*66.09*	
Chromium	*0.52*	*51.84*	*10.37*			*198.32*	
Iron	0.86	401.76	12.10		1100.86		
Zinc	0.65	34.56	4.32		190.09	*0.86*	
Mercury					21.55		

REACH Q

TABLE A30
Page 1 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	403	407	409	415	417	419	421
TKN	51.84	4.75	6.96	120.96	5.62	10.37	3.89
NH_3-N	6.48	0.86	1.99	17.28	0.86	2.59	0.86
NO_2-N							
NO_3-N							
Phosphorus - Total	10.37	0.26	0.50	12.10	0.48	0.52	0.39
Phosphorus - Soluble	3.89	0.17	0.40	3.46	0.35	0.52	0.26
BOD	194.4	21.6	59.6	864	31.7	25.9	21.6
COD	972.0	103.7	165.6	1555.2	69.1	103.68	103.7
Fecal Coliforms	340	178	5699	120	26415	6504	32
Fecal Strepto-cocci (count/100 ml)	440	167	4325	160	22551	4503	379
Phenolics (mg/day)	0.05		0.03				
Suspended Solids VSS (%)	648	13	141	346	13	143	17
Lead	5.18	0.69	1.61	13.82	0.69	2.07	0.69
Copper	1.30	0.17	0.40	3.46	0.17	0.52	0.17
Chromium	3.89	0.52	1.21	10.37	0.52	1.56	0.52
Iron	2.59	2.51	7.66	29.37	1.12	1.42	0.91
Zinc	2.59	0.26	2.02	5.19	0.17	0.91	0.44
Mercury							

REACH Q

TABLE A3Q
Page 2 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	423	427	431	433			
TKN	21.60	16070.4	345.60	64.28			
NH_3-N	4.32	2678.40	43.20	16.07			
NO_2-N							
NO_3-N							
Phosphorus - Total	2.81	1607.04	34.56	12.05			
Phosphorus - Soluble	1.30	1607.04	8.64	33.75			
BOD	237.6	80352	1728.0	417.8			
COD	1274.4	535680	7776.0	1092.8			
Fecal Coliforms	188	140	10	13416			
Fecal Streptococci (count/100 ml)	45	129	10	7115			
Phenolics (mg/day)	0.01	5.36					
Suspended Solids VSS (%)	562	107136	3888	402			
Lead	3.46	2142.72	34.56	12.86			
Copper	0.86	535.68	8.64	3.21			
Chromium	2.59	1607.04	125.28	9.64			
Iron	7.35	5624.6	34.56	6.43			
Zinc	2.38	538.4	8.64	4.02			
Mercury							

REACH Q

TABLE A30
Page 3 of 3

OUTFALL LOADING SHEET

Parameter \ Outfall	Average Contaminant Loading (g/day)						
	With#427	Total A	*Total B*	Without#427	Total A	*Total B*	
TKN	16709	21838			635.9		
NH_3-N			*2773*			*94.5*	
NO_2-N							
NO_3-N							
Phosphorus - Total		1681.1			74.0		
Phosphorus - Soluble		1646.6	*13.19*		39.6	*13.2*	
BOD		83928	*25.9*		3576.3	*25.9*	
COD		548896			13216.2		
Fecal Coliforms							
Fecal Streptococci (count/100 ml)							
Phenolics (mg/day)		0.09	*5.36*		0.09		
Suspended Solids VSS (%)		113309			6173		
Lead			*2218.4*			*75.6*	
Copper			*554.6*			*18.9*	
Chromium		125.28	*1637.9*		125.28	*30.8*	
Iron		5781.2	*9.02*		156.6	*9.02*	
Zinc		556.2	*8.81*		17.81	*8.81*	
Mercury							

TABLE A4 - DETECTION LIMITS USED IN DATA ANALYSIS

A5 LABORATORY TECHNIQUES AT METROPOLITAN TORONTO DEE AVENUE LABORATORY

TABLE A4:

DETECTION LIMITS USED IN DATA ANALYSIS

PARAMETER		DETECTION LIMIT
Total Phosphorus		0.02 mg/L
Soluble Phosphorus		0.02 mg/L
TKN		0.2 mg/L
NH_3-N		0.1 mg/L
NO_2-N		0.01 mg/L
NO_3-N		0.1 mg/L
Phenols		0.2 µg/L
Lead	(Pb)	0.08 mg/L
Copper	(Cu)	0.02 mg/L
Chromium	(Cr)	0.06 mg/L
Iron	(Fe)	0.04 mg/L
Zinc	(Zn)	0.02 mg/L
Mercury	(Hg)	0.03 ug/L

In general the procedures set out in Standard Methods for the Examination of Water and Wastewater, 15th Edition, 1980 were followed. Below are further details of the analytical procedures:

SUSPENDED SOLIDS: This is synonymous with total non-filtrable residue. The material is retained on a glass fibre filter disk 2.4 cm in diameter (Whatman 934-AH) held in a Gooch crucible. Ordinarily 500 ml of sample is filtered and the residue dried at 103-105°C. For samples with a great deal of suspended matter a 12.5 cm diameter glass fibre filter paper is used with a Buchner funnel. In both cases vacuum is applied using a water aspiration filter pump.

VOLATILE SUSPENDED SOLIDS: The filter disk with residue is ignited for 15 minutes at 550±50°C. The % volatile residue is the value given under the heading VSS in the tables.

BIOCHEMICAL OXYGEN DEMAND: At least two dilutions of each sample are used unless the sample is straight seeded. A 120 ml BOD bottle is employed. The seed is primary effluent supplied by the Humber Treatment Plant and is used in a concentration of 5 ml/litre of dilution water. The concentration of dissolved oxygen is measured with a Yellow Springs Instrument 54A Oxygen Meter.

In cases where there is a choice among possible BOD values, the graphical method developed by Klein and Gibbs is applied to the data.

COD would use up more than 50% of the dichromate. A dilution factor (df) was estimated using the relationship df = COD/50 where the COD can be approximated by doubling the known BOD value (i.e. previously determined).

The accuracy of the COD determination is seriously affected by contamination or reagent impurities. To overcome these difficulties, the glassware is cleaned immediately before use and blanks were run with each set of samples.

SAMPLE TREATMENT: The samples were refrigerated at 7°C on reception. Suspended solids and BODs were done the same day as received. CODs and metals were usually done within the following ten days. If a value seemed suspect the determination was redone. Necessarily this would mean at least five days between successive BOD determinations on the same sample.

METALS: All the glassware used is first acid-washed. A 250 ml sample (preserved in the field with 10 drops conc. nitric acid per 500 ml) has 1.5 ml conc. nitric acid added to it as well as anti-bumping granules and the sample evaporated to 25 ml volume, left to cool and then filtered through Whatman No. 1 filter paper. It was found that the filter paper was very easily contaminated by contact with the skin giving high zinc values to the filtrate and so trutouch vinyl gloves were used when folding the filter paper. The 15 ml volume from preconcentration was made up to 50 ml volume in a volumetric flask and the metals in the solution determined on a Pye Unicam SP90A Series 2 Atomic Absorption Spectrophotmeter (purchased in 1971). Because there is no automatic background correction facility on this machine, the background measurement was made for zinc and lead using the non-absorbing lines of 206.2 nm and 220.3 nm respectively and manually subtracting the absorption reading. Detection limits were determined practically as the concentration which would produce an absorbance of 0.2 under standard conditions. With the solutions of this study the detection limits are: Zn 0.02 mg/L, Pb 0.08 mg/L, Cu 0.02 mg/L, Cr 0.06 mg/L and Fe 0.04 mg/L.

CHEMICAL OXYGEN DEMAND: For apparently 'clean' samples, 20 ml is put in a 250 ml erlenmeyer with a 24/40 neck fitted with a reflux condenser. To the sample is added 0.5 g HgSO4, 10 ml of 0.025 M $K_2Cr_2O_7$, boiling chips and 30 ml of conc. H_2SO_4 ($+Ag_2SO_4$)and the mixture refluxed for 1½ hours. The cooled sample was diluted to twice its volume with distilled water and then titrated with 0.025N ferrous ammonium sulfate using ferroin as an indicator. COD values up to 100 are handled with this procedure. For higher values, sample dilution is required. Allowing a safety margin, dilution should be considered when the

APPENDIX B

ANALYTICAL CHEMISTRY AND FECAL BACTERIA DATA
(SUBMITTED SEPARATELY)

APPENDIX C

Field Data Sheets

Volume I   Outfalls 1-420

Volume II   Outfalls 421-741

(Submitted Separately)

APPENDIX D

TABLE D1	NUMERICAL LISTING OF OUTFALL LOCATIONS
TABLE D2A-Q	OUTFALL LIST

(SUBMITTED SEPARATELY)